CHAPTER 9
Abstractness and psychological reality

PREVIEW

This chapter explores the extent to which underlying and surface forms can be different – what constraints if any are tenable within the formal theory, what the issues are in limiting abstractness, and how to address these questions empirically. The central question raised in this chapter is "what counts as evidence for a phonological analysis?"

KEY TERMS

abstractness

absolute neutralization

psychological reality

external evidence

A fundamental question in the theory of phonology has been "how abstract is phonology?", specifically, how different can the underlying and phonetic forms of a word be? The essential question is whether grammars use entities that are not directly observed. Related to this is the question of whether a linguistic model requiring elements that cannot be directly observed reflects what the human mind does. The very concept of a mental representation of speech, such as a phonological surface form like [sɔks] *socks* which is not itself an directly observable physical event, requires abstracting away from many specifics of speech. The basis that we draw on in creating a transcription [sɔks] is a number of direct observaions, but we do not observe transcriptions (other than saying "yes, I see somethnig written"). Without generalizing beyond the directly observable, it would be impossible to make even the most mundane observations about any language, or anything else in the universe. The question is therefore not whether phonology is abstract at all, but rather what degree of abstractness is required and justified.

Here (and following the presumptions make in phonological practice), the "concrete" is that which we observe using our finest-grained transcriptional tools, reduced to a standard transcriptional scheme. If underlying representations are fully concrete – if they are the same as surface representations – the underlying forms of English [k^hɔrts] *courts* and [k^howdz] *codes* would be /k^hɔrt-s/ and /k^howd-z/. Such an extremely surface-oriented view of phonology would ignore the fact that the words have in common the plural morpheme, whose pronunciation varies according to the environment. We would be forced to say that these two words select different plural suffixes, because they are pronounced differently. By hypothesizing that the underlying form of [k^hɔrts] is /k^hɔrt-z/, we can say that the plural pronounced *s* in [k^hɔrts] and the plural pronounced *z* in [k^howdz] are one and the same thing. Such abstractness in phonological analysis yields the benefit of explaining the similarities in pronunciation of the various realizations of the plural morpheme, and this degree of abstractness has not been questioned.

9.1 Why limit abstractness?

First we must understand what motivates concern over abstractness.

9.1.1 Limiting possible analyses

One reason to limit the divergence between underlying and surface forms is to constrain the theory of phonology, to prevent it from making wrong claims about how languages work. With no constraint on abstractness, every conceivable derivation from underlying to surface form would in principle be allowed by the theory. Just as the theory of phonology seeks to constrain the concept of "possible rule," so that an imaginable rule such as {s, p, q, r} → {m, l, t, v} / _ {s, k, ə, m} (unattested in any human language) can be ruled out on formal grounds, so too might we wish to rule out a derivation from underlying /qøɬijʌ/ to surface [gəˈraʒ] as too abstract. Since a goal of linguistic theory has been to restrict the class of theoretically possible languages to just the type that is actually observed, limiting abstractness in a well-defined way limits the number of possible languages, which has been one of the presumed goals of linguistic theory.

Another reason for concern over abstractness is that it makes a particular claim about human cognition, that the mentally stored units of language can include things that the speaker has not actually heard, but only arrived at by inference based on a line of indirect evidence. Since first language acquisition does not proceed by conscious reasoning of the type demanded in your phonology class, it cannot be taken for granted that everyday academic reasoning skills are automatically available to children.

Mental reality and language acquisition. This second consideration, whether abstractness (of some particular degree) is part of human cognitive capacity, is the most important question arising in this debate: this is a fundamental consideration for a theory such as generative grammar that seeks a model of language in the mind. Because the details of specific languages are not built into children at birth but must be induced from the ambient linguistic data aided by general cognitive capacity and whatever language faculty is universally available to all humans (i.e. the theory of grammar), a basic concern regarding the psychological reality of grammatical constructs – for phonology, rules and underlying forms – is whether they can be learned from the primary language data.

The role of a universal grammatical component is to make the job of language acquisition easier, by uncompromisingly removing certain kinds of imaginable descriptions from consideration. Distinctive features are one way of making this job easier, since it limits the ways of analyzing data. Universal constraints on abstractness might similarly help a child trying to arrive at underlying representation for a language, and there have been a number of proposals as to the relationship between the underlying and surface forms. Attractive as it might seem to propose formal constraints on the theory of grammar to prohibit English from having /qøɬijʌ/ be the underlying form of [gəˈraʒ] *garage*, we will not assume that this is a matter for the formal theory of grammar; rather, it is a consequence of how a phonology is learned, thus the question of abstractness is outside the domain of grammatical theory.

Faced with a word pronounced [dɔg], a child learning English has no reason to assume that its underlying form is anything other than /dɔg/. But faced with the word *atom* [ˈæɾəm] and the related word *atomic* [əˈtʰɔmɪk], the child needs to arrive at an underlying representation for the root on which these two words are based, such that rules of English phonology can apply to derive the phonetic variants [ˈæɾəm] and [əˈtʰɔm-ɪk]: an appropriate representation would be [ætɔm]. It is in the face of such a specific motivation for an abstract underlying form that we would assume the underlying form isn't simply the surface form. The solution to the so-called problem of abstractness which will be adopted here is, simply, that abstractness per se is not a problem: what really requires investigation is the kind of evidence that properly motivates a phonological analysis.

Abstractness and phonemic representations. One particular degree of abstractness is widely accepted as self-evident, needing no further justification, namely that underlying representations do not contain allophonic variants of phonemes. It is generally assumed that English [stɔp], [tʰɔp] are underlyingly /stɔp/, /tɔp/, without aspiration, because there is (by assumption) no underlying aspiration in English. Similarly, we know that the underlying form of [hɪɾɪŋ] *hitting* is /hɪtɪŋ/, not only because the flap is an allophone in English, but also because of the related word [hɪt] *hit* where the [t] is directly pronounced. Thus, it is commonly assumed that underlying forms are *at least* as abstract as phonemic representations, with all allophonically predictable features eliminated.

This assumption can lead to problems. What is the medial consonant in the underlying form of a word like [waɾ̩] 'water'? Assuming that the flap is not a phoneme in English (there are no minimal or near-minimal pairs contrasting [t] or [d] vs. [ɾ]), this forces us to say that it must be something other than [ɾ]. The word is spelled with *t*, but spelling is not relevant to underlying representations. Children acquire words without knowing how to spell, and very many languages of the world are unwritten yet underlying representations must be acquired for all human languages. Spelling is also unreliable, and could lead us to the unjustified conclusion that the underlying vowels of [tuw] *too*, *to*, *two*, [θruw] *through*, [duw] *due* and [druw] *drew* are all different.

Since [waɾ̩] is not composed of a root plus suffix, we cannot look at related forms to reveal the underlying consonant (as we can in *wad-er* versus *wait-er*, both [wejɾ̩]). Any number of hypotheses could be set forth – /waɾ̩/, /wat̩/, /wad̩/, /wað̩/, /waβ̩/, /waɣ̩/ and so on. Hypotheses like /waβ̩/ and /waɣ̩/ can be rejected on the grounds that they are pointlessly abstract, containing segments which do not occur phonetically in English, and there is no reason to believe that they exist underlyingly. Nothing is gained by positing such underlying representations, thus nothing justifies these hypotheses. Two facts argue decisively against hypothetical /waβ̩/, /waɣ̩/ and their ilk. First, there is no evidence for a rule in English effecting the change /ɣ/ → [ɾ] or /β/ → [ɾ] and addition of such a rule, required to convert the underlying form into the surface form, rules against such an analysis since there exist analyses which at least do not force the inclusion of otherwise unmotivated rules. Second, a specific choice between /waβ̩/ and /waɣ̩/, or /waʔ̩/ and innumerable other possibilities which also lack an underlying flap, is totally arbitrary and leaves the language analyst – student and child alike – with the unresolvable puzzle "why *this* underlying form and not some other?", which can only be resolved by fiat.

The hypothesis /waðɻ/ is less abstract since it is composed only of observed segments of English; it is, however, factually wrong, because it would be impossible to craft rules for English to turn /ð/ into a flap in this context (consider *father*, *bother*, *weather* which indicate that there cannot be a rule changing /ð/ into a flap in some context). Only three hypotheses remain viable: /waɾɻ/, /watɻ/, and /wadɻ/. None of these hypotheses posits surface nonexistent segments, and given the rules of English – Flapping, specifically – any of these underlying representations would result in the correct surface form.

There is no standard answer to the question of the underlying form of *water*, but certain arguments can be marshalled to support different positions. We initially rejected the theory that the underlying form might be /waɾɻ/ because it posits what we assumed to be a nonexistent underlying segment in the language, but we should reconsider that decision, to at least explain our argument for rejecting an underlying flap. Hypothesizing /waɾɻ/ necessitates another phoneme in the inventory of English underlying segments, violating an analytic economy principle which says that you should select a parsimonious underlying inventory for a language. This perhaps reflects the basic principle of scientific reasoning that simpler, more economical solutions are better than complicated solutions that posit unnecessary machinery. But no concrete linguistic arguments indicate that elimination of phonemes is an actual goal of phonological acquisition. Economy of the underlying inventory cannot be judged in a theoretical vacuum, and in at least one contemporary theory, Optimality Theory, it is impossible to state generalizations about underlying representations, so it is impossible in that theory to say that English has no underlying flap. Furthermore, the economization is very local, specific to how many entities exist in underlying forms. Whatever cost attaches to saying that "ɾ exists", it must be paid when the flapping rule applies.

A somewhat stronger argument against allowing an underlying flap is that the surface distribution of [ɾ] is restricted. It only appears between vocoids (vowels and glides), and only if the following vowel is unstressed, which is precisely the context where /t,d/ actively are changed into the flap [ɾ] (*hit* [hɪt] ~ *hitting* [hɪɾɪŋ]; *hide* [hajd] ~ *hiding* [hajɾɪŋ]). We can explain the lack of words in English like *[hiɾ], *[ɾuwl], *[æfɾ̩] and *[əɾǽk], if we assume that the flap [ɾ] is not in the inventory of underlying segments of English, and only derives from /t/ or /d/ by this specific rule. This argument recognizes the importance of capturing major generalizations about language, which is the central concern of linguistics: it says that it would be too much of a coincidence if, in assuming underlying /ɾ/ in *water*, we failed to note that underlying flap only appears in a very few contexts.

This argument is founded on the presumption that distribution of segments in underlying forms cannot be restricted: otherwise we would simply state a restriction on where underlying flaps appear and let the underlying form of [waɾɻ] be fully concrete. Some theories do not have conditions on underlying forms (Optimality Theory), others do. Something like conditions on underlying forms seems inevitable, since for example there cannot be any words in English of the form sC_iVC_i, hence **slil, *sneen, *spup, *skuck*; yet, it is uncertain what status such conditions have in the theory of grammar. The assumption that all regularities about a language must be captured in the grammar has been a fundamental assumption for many theories of phonology, but has also been

challenged (see Hale & Rice 2006), so we cannot take it for granted that the grammar is solely responsible for explaining the distribution of the flap in English.

Still, even if we decide that the underlying form doesn't have a flap, that leaves open the choice between /t/ and /d/, which is purely arbitrary. The choice might be made by appealing to markedness (chapter 8), insofar as [t] is a less marked, i.e. crosslinguistically common, segment than [d]. Whether this reasoning is correct remains to be determined empirically.

9.1.2 A principled limit on abstractness?

In connection with our first neutralization rule in this book, final devoicing in Russian (chapter 5), we explained the alternation [porok] 'threshold (nom sg)' ~ [poroga] 'threshold (gen sg)' by saying that underlyingly the stem ends with /g/. The abstract representation /porog/ for [porok] 'threshold (nom sg)' is justified by the fact that [porok] and [poroga] have the same root morpheme, and /porog/ is one of the two actually occurring pronunciations of the morpheme. In hypothesizing underlying forms of morphemes, we have repeatedly emphasized the utility of considering any and all of the surface realizations of a given morpheme as candidates for being the underlying form. One might even advance a formal principle regarding abstractness (a principle to this effect was proposed in the theory of Natural Generative Phonology, see Vennemann 1974):

(1) The underlying form of a morpheme must actually be pronounced as such in some surface form containing the morpheme

The underlying cognitive presupposition of such a principle is that humans only abstract the nature of morphemes by directly selecting from tokens of perceptual experience with that unit.

When you look at a broad range of phonological analyses, it very often turns out that the supposed underlying form of a morpheme is indeed directly observed in some surface form. Nonetheless, such a principle cannot be an absolute condition on the relation between underlying and surface forms, that is, it cannot be a principle in the theory of grammar. Recall from chapter 5 that in Palauan, all unstressed vowels become schwa, and underlying forms of roots may contain two full vowels, for example /daŋob/ 'cover,' /teʔib/ 'pull out,' /ŋetom/ 'lick.' We are justified in concluding that the first vowel in /daŋob/ is /a/ because it is actually pronounced as such in [mə-ˈdaŋəb] when the first root vowel is stressed, and we are justified in concluding that the second vowel is /o/ because that is how it is pronounced in [dəˈŋobl]. Although each hypothesized underlying vowel can be pronounced in one surface variant of the root or another, no single surface form actually contains both vowels in their unreduced form: the hypothesized underlying form /daŋob/ is never pronounced as such, thus our analysis of Palauan is a counterexample to the excessively restrictive statement (1). Similar examples come from English (cf. the underlying stem /tɛlɛgræf/ which explains the surface vowel qualities in [ˈtɛləgræf] and [təˈlɛgrəf-ij]) and Tonkawa (cf. /picena/ which is justified based on the surface forms *picna-n-oʔ* and *we-pcen-oʔ*). Condition (1) also runs into problems in Yawelmani (chapter 7), which has a rule shortening a long vowel before a cluster of two consonants,

and another rule inserting *i* after the first of three consonants. The two rules apply in stems such as /ʔa:ml/, so that epenthesis turns /ʔa:ml-hin/ into [ʔa:mil-him], and shortening turns /ʔa:ml-al/ into [ʔamlal]. The problem for (1) is that /ʔa:ml/ can never be pronounced as such, since either the vowel is shortened, or else *i* is inserted.

Rather than abandon the enterprise of doing phonology in these languages out of misguided allegiance to an a priori assumption about the relationship between underlying and surface forms, we might consider a weaker constraint, which allows underlying forms of morphemes to be composed of segments that are actually pronounced in some attestation of the morpheme, but disallows representations that are more abstract.

(2) The underlying form of a word must contain only segments actually pronounced as such in some related word containing the morpheme

Even this cannot be an absolute requirement. One case that runs afoul of this condition is the case of stem-final voiced stops in Catalan (chapter 6, problem 7). There is a rule devoicing final obstruents, and another rule spirantizing intervocalic voiced stops. These rules result in alternations such as *sɛk* 'dry (masc)' ~ *sɛkə* 'dry (fem)' from /sɛk/, versus *sek* 'blind (masc)' ~ *seɣə* 'blind (fem)' from /seg/. The underlying voiced stop /g/ is not directly attested in any form of the stem /seg/, and thus runs afoul of constraint (2).

Another counterexample to (2) is Hehe (chapter 7). That language has a rule assigning H tone to a penultimate vowel which is not also immediately preceded by a H. This rule accounts for the position of the second H tone in words like *kú-kam-íl-a* 'to milk for,' *kú-kam-il-án-a* 'to milk for each other,' and the lack of H tone in *kú-kam-a* 'to milk' where the penultimate vowel is preceded by an H-toned vowel. Surface forms such as *kú-kam-j-á* 'to cause to milk' and *kú-kam-w-á* 'to be milked' would seem to be exceptions, but actually they follow the general pattern perfectly, as long as we recognize that the underlying forms are /kú-kam-i-a/ and /kú-kam-u-a/. Given those underlying forms, the H is regularly assigned to the penultimate vowel giving *kú-kam-í-a* and *kú-kam-ú-a*, and then the high vowels become glides before a vowel, causing the H tone to be transferred to the final vowel. The important point about these examples is that the assumed vowels of the causative and passive never surface as vowels: they appear only as glides, since by quirks of Hehe morphology, the morphemes *-i-* and *-u-* are always followed by a vowel suffix, so they always undergo glide formation.

7.1.3 Case studies in abstract analysis

We will look in depth at two cases of abstract phonological analysis, one from Matuumbi and one from Sanskrit, where abstract underlying forms are well motivated; these are contrasted with some proposals for English, which are not well motivated. Our goal is to see that the problem of abstractness is not about the formal phonetic distance between underlying and surface forms, but rather it involves the question of how strong the evidence is for positing an abstract underlying representation.

Abstract *mu* in Matuumbi. Matuumbi provides an example of an abstract underlying representation, involving an underlying vowel which never surfaces as such. In this language, the noun prefix which marks nouns of lexical class 3 has a number of surface

realizations such as [m], [n], [ŋ] and [mw], but the underlying representation of this prefix is /mu/, despite the fact that the prefix never actually has that surface manifestation with the vowel *u*.

We begin with the effect which nasals have on a following consonant. Sequences of nasal plus consonant are subject to a number of rules in Matuumbi, and there are two different patterns depending on the nature of the nasal. One such nasal is the prefix /ɲ-/, marking nouns and adjectives of grammatical class 9. When this prefix comes before an underlyingly voiced consonant, the nasal assimilates in place of articulation to that consonant, by a general rule that all nasals agree in place of articulation with an immediately following consonant.

(3)	*Adjective* (cl 9)	*Verb*	
	m-bomwáaná	bómwaana	‘pointlessly destroy’
	ŋ-golóká	góloka	‘be straight’
	ɲ-dʒilúká	dʒíluka	‘fall down’

When added to a stem beginning with a nasal consonant, the nasal deletes.

(4)	*Adjective* (cl 9)	*Verb*	
	mamáandwá	mámaandwa	‘nail’
	mimíná	mímina	‘spill’
	namátá	námata	‘be sticky’

The prefix /ɲ/ causes a following voiceless consonant to become voiced.

(5)	*Adjective* (cl 9)	*Verb*	
	n-dɪníká	tínɪka	‘cut’
	n-demá.á	téma	‘chop’
	ɲ-dʒapíitʃá	tʃápiitʃa	‘be clean’

Finally, /ɲ/ causes a following glide to become a voiced stop, preserving the place properties of the glide.

(6)	*Adjective* (cl. 9)	*Verb*	
	ɲ-dʒukúta	júkuta	‘be full’
	ŋ-gwaá.á	wá	‘die’
	ŋ-gwɪkíljá	wíkɪlja	‘cover’

We know that the prefix is underlyingly /ɲ/ because that is how it surfaces before vowel-initial adjectives such as *ɲ-epeési* ‘light (cl 9),’ *ɲ-iípi* ‘short (cl 9).’

Different effects are triggered by the nasal of the prefix /mu/ which marks second-plural subjects on verbs. This prefix has the underlying form /mu/, and it can surface as such when the following stem begins with a consonant.

(7)	mu-buundíke	‘you should store’

	mu-laabúke	‘you should breakfast’
	mu-dʒiiŋgí	‘you should enter’
	mu-goóɲdʒe	‘you should sleep’

A rule deletes the vowel *u* preceded by *m* when the vowel precedes a consonant (you observed this rule in chapter 6), and this rule applies optionally in this prefix. Before a stem beginning with a voiced consonant, deletion of the vowel results in a cluster of a nasal plus a consonant, and *m* causes nasalization of the following consonant (compare the examples in (7) where the vowel is not deleted).

(8)		
	m-muundíke	‘you should store’
	n-naabúke	‘you should breakfast’
	ɲ-ɲiiŋgí	‘you should enter’
	ŋ-ŋoóɲdʒe	‘you should sleep’

This reveals an important difference between the two sets of postnasal processes. In underlying nasal C sequences such as /ɲ-bomwáaná/ → *m-bomwáaná* ‘destroyed (cl 9),’ the nasal only assimilates in place of articulation to the following C, but in nasal + consonant sequences derived by deletion of *u*, the prefixal nasal causes nasalization of a following voiced consonant.

Another difference between /ɲC/ versus /muC/ is evident when the prefix /mu/ comes before a stem beginning with a nasal consonant. The data in (9) show that when *u* deletes, the resulting cluster of nasals does not undergo nasal deletion. (The reason for this is that /mu/ first becomes a syllabic nasal m̩, and nasalization takes place after a syllabic nasal.)

(9)			
	mu-mímiine	m-mímiine	‘you (pl) spilled’
	mu-nóolite	n-nóolite	‘you (pl) sharpened’
	mu-ŋáandite	ŋ-ŋáandite	‘you (pl) played’

In comparison, class 9 /ɲ-miníná/ with the prefix /ɲ/ surfaces as *miníná* ‘spilled (cl 9),’ having undergone degemination.

A third difference between /ɲ + C/ versus /mu+C/ emerges with stems that begin with a voiceless consonant. As seen in (10), /mu/ simply assimilates in place of articulation to the following voiceless consonant.

(10)			
	mu-paánde	m-paánde	‘you should plant’
	mu-teleké	n-teleké	‘you should cook’
	mu-tʃoné	ɲ-tʃoné	‘you should sew’
	mu-kalaáŋge	ŋ-kalaáŋge	‘you should fry’

Remember, though, that /ɲ/ causes a following voiceless consonant to become voiced, so /ɲ-tɪníká/ → *ndɪníká* ‘cut (cl 9).’

Finally, /mu/ causes a following glide to become a nasal at the same place of articulation as the glide.

(11)	mu-wɪkɪlí	ŋ-ŋwɪkɪlí	‘you should cover’
	mu-jɪkɪtí	ɲ-ɲɪkɪtí	‘you should agree’

Underlying /ɲ/, on the other hand, causes a following glide to become a voiced stop, cf. /ɲ-wɪkíljá/ → *ŋ-gwɪkíljá* ‘covered (cl 9).’

The differences between /ɲ/ and /mu/ go beyond just their effects on following consonants: they also have different effects on preceding and following vowels. In the case of /mu/, the preceding vowel lengthens when *u* deletes.

(12)	iwɪkɪljó mu-toóle	‘you should take cover’
	iwɪkɪljóo n-toóle	id.
	ɲuúmba mu-bomwaáne	‘you should destroy the house’
	ɲuúmbaa m-momwaáne	id.

On the other hand, /ɲ/ has no effect on the length of a preceding vowel.

(13)	iwɪkɪljo m-bwapwáaniká	‘broken cover’
	ɲumbá m-bomwáaná	‘destroyed house’

Finally, /ɲ/ surfaces as [ɲ] before a vowel and the length of the following vowel is not affected. But /mu/ surfaces as [mw] before a vowel due to a process of glide formation, and the following vowel is always lengthened.

(14)		*Stem*		
	/ɲ/	/iípi/	ɲ-iípi	‘short (cl 9)’
		/epeési/	ɲ-epeési	‘light (cl 9)’
	/mu/	/ɪímb-e/	mw-ímb-e	‘you should dig’
		/eleéw-e/	mw-eeleéw-e	‘you should understand’

A number of properties distinguish /mu/ from /ɲ/. Apart from the important fact that positing these different underlying representations provides a phonological basis for distinguishing these effects, our choices of underlying forms are uncontroversial, because the posited forms of the prefixes are actually directly attested in some surface variant: recall that the second-plural verbal subject prefix /mu/ can actually be pronounced as [mu], since deletion of /u/ is optional for this prefix.

Deletion of u is obligatory in this prefix and optional in the subject prefix because subject prefixes have a “looser” bond to the following stem than lexical class prefixes, which are joined with the stem to form a special phonological domain.

Now we are in position to discuss a prefix whose underlying representation can only be inferred indirectly. The prefix for class 3 nouns and adjectives is underlyingly /mu/, like the second-plural verbal subject prefix. Unlike the verb prefix, the vowel /u/ of the class 3 noun prefix always deletes, and /mu/ never appears as such on the surface – its underlying presence can only be inferred indirectly. A strong indication that this prefix is underlyingly /mu/ is the fact that it has exactly the same effect on a following consonant

as the reduced form of the subject prefix *mu* has. It causes a voiced consonant to become nasalized.

(15)	*Infinitive*	*Adjective* (cl 3)	
	búundika	m-muúndiká	‘store’
	láabuka	n-naábuká	‘breakfast’
	dʒíiŋgja	ɲ-ɲiíŋgjá	‘enter’
	góoɲdʒa	ŋ-ŋoóɲdʒá	‘sleep’

It forms a geminate nasal with a following nasal.

(16)	*Infinitive*	*Adjective* (cl 3)	
	máta	m-matá.á	‘plaster’
	múlika	m-mulíká	‘burn’
	námata	n-namátá	‘be sticky’

It also does not cause a following voiceless consonant to become voiced.

(17)	*Infinitive*	*Adjective* (cl 3)	
	páanda	m-paándá	‘plant’
	téleka	n-teléká	‘cook’
	tʃóna	ɲ-tʃoná.á	‘sew’
	kálaaŋga	ŋ-kaláaŋgá	‘fry’

Another reason to believe that this prefix is underlyingly /mu/ is that when it comes before a stem beginning with a vowel, the prefix shows up as [mw] and the following vowel is lengthened.

(18)	*Infinitive*	*Adjective* (cl 3)	
	álibika	mwaalíbiká	‘break’
	épuka	mweepúká	‘avoid’
	íɪmba	mwɪímbá	‘dig’
	ótoka	mwootóká	‘puncture’

Under the hypothesis that the class 3 prefix is /mu/, we automatically predict that the prefix should have this exact shape before a vowel, just as the uncontroversial prefix /mu/ marking second-plural subject has.

Finally, the data in (19) show that this prefix has the same effect of lengthening the preceding vowel as the second-plural subject prefix has.

(19)	mwoógo	‘cassava’	mwoogoo m-moú	‘rotten cassava’
	mpɪlá	‘football’	mpɪláa m-puwáaniká	‘broken football’
	nkóta	‘sweets’	nkotaa n-nogá.á	‘good sweets’

nkwá ‘spear’ nkwáa n-kóló ‘big spear’

The only reasonable assumption is that this prefix is underlyingly /mu/, despite the fact that the vowel *u* never actually appears as such.

Direct attestation of the hypothesized underlying segment would provide very clear evidence for the segment in an underlying form, but underlying forms can also be established by indirect means, such as showing that one morpheme behaves in a manner parallel to some other which has a known and uncontroversial underlying form. Thus the fact that the class 3 prefix behaves in all other respects exactly like prefixes which are uncontroversially /mu/ suffices to justify the conclusion that the class 3 prefix is, indeed, /mu/.

Abstract /ai/ and /au/ in Sanskrit. A significantly more abstract representation of the mid vowels [e:,o:] is required for Sanskrit. These surface vowels derive from the diphthongs /ai/, /au/, which are never phonetically manifested anywhere in the language. The surface vowels (syllabics) and diphthongs of Sanskrit are in (20).

(20) a i u ṛ ḷ a: e: i: o: u: ṛ: a:i a:u

Two things to be remarked regarding the inventory are that while the language has diphthongs with a long first element *a:i, a:u*, it has no diphthongs with a short first element. Second, the mid vowels only appear as long, never short. These two facts turn out to be related.

One phonological rule of the language fuses identical vowels into a single long vowel. This process operates at the phrasal level, so examples are quite easy to come by, simply by combining two words in a sentence.

(21)	na ‘not’ + asti ‘is’	→	na:sti	‘is not’
	na ‘not’ + a:ste: ‘he sits’	→	na:ste:	‘he doesn’t sit’
	nadi: ‘river’ + iwa ‘like’	→	nadi:wa	‘like a river’
	jadi ‘if’ + i:çwarah ‘lord’	→	jadi:çwarah	‘if the lord’
	nadi: ‘river’ + i:çwarah ‘lord’	→	nadi:çwarah	‘lord river’
	sa:dhu ‘well’ + uktam ‘said’	→	sa:dhu:ktam	‘well said’

A second process combines long or short *a* with *i* and *u* (long or short), giving the long mid vowels *e:* and *o:*.

(22)	ca ‘and’ + iha ‘here’	→	ce:ha	‘and here’
	ca ‘and’ + uktam ‘said’	→	co:ktam	‘and said’
	sa: ‘she’ + uktam ‘said’	→	so:ktam	‘she said’
	sa: ‘she’ + i:çwara ‘O Lord’	→	se:çwara	‘she, O Lord’

These data point to an explanation for the distribution of vowels noted in (20), which is that underlying *ai* and *au* become *e:* and *o:*, and that this is the only source of mid vowels in the language. This explains why the mid vowels are all long, and also explains why there are no diphthongs **ai*, **au*. There is also a rule shortening a long vowel before

another vowel at the phrasal level, which is why at the phrasal level /a:/ plus /i/ does not form a long diphthong [a:i].

There is a word-internal context where the short diphthongs *ai* and *au* would be expected to arise by concatenation of morphemes, and where we find surface *e:, o:* instead. The imperfective tense involves the prefixation of *a-*.

(23)	bhar-at-i	'he bears'	a-bhar-at	'he bore'
	tuɲɟ-at-i	'he urges'	a-tuɲɟ-at	'he urged'
	wardh-at-i	'he grows'	a-wardh-at	'he grew'

If the stem begins with the vowel *a*, the prefix *a-* combines with following *a* to give a long vowel, just as *a* + *a* → *a:* at the phrasal level.

(24)	aɟ-at-i	'he drives'	a:ɟ-at	'he drove'
	aɲc-at-i	'he bends'	a:ɲc-at	'he bent'

When the root begins with the vowels *i*, *u*, the resulting sequences *ai*(:), *au*(:) surface as long mid vowels:

(25)	il-at-i	'he is quiet'	e:l-at	'he was quiet'
	i:kʂ-at-i	'he sees'	e:kʂ-at	'he saw'
	ukʂ-at-i	'he sprinkles'	o:kʂ-at	'he sprinkled'
	ubɟ-at-i	'he forces'	o:bɟ-at	'he forced'

These alternations exemplify the rule where /ai,au/ → [e:,o:].

We have shown that /a + i, a + u/ surface as [e:,o:], so now we will concentrate on the related conclusion that [e:,o:] derive from underlying /ai, au/. One argument supporting this conclusion is a surface generalization about vowel combinations, that when *a* combines with what would surface as word initial *o:* or *e:*, the result is a long diphthong *a:u, a:i*.

(26)	a.	ca 'and' + o:kʂat 'he sprinkled'	→	ca:ukʂat	'and he sprinkled'
		ca 'and' + e:kʂat 'he saw'	→	ca:ikʂat	'and he saw'
	b.	ca 'and' + ukʂati 'he sprinkles'	→	co:kʂati	'and he sprinkles'
		ca 'and' + i:kʂati 'he sees'	→	ce:kʂati	'and he sees'

This fusion process makes sense given the proposal that [e:] and [o:] derive from /ai/ and /au/. The examples in (26b) remind us that initial [e:,o:] in these examples transparently derive from /a + i/, /a + u/, because in these examples /a/ is the imperfective prefix and the root vowels *u,i* can be seen directly in the present tense. Thus the underlying forms of [ca:ukʂat] and [ca:ikʂat] are [ca#a-ukʂat] and [ca#a-ikʂat]. The surface long diphthong derives from the combination of the sequence of *a*'s into one long *a:*. The same pattern holds for all words beginning with mid vowels, even when there is no morphological justification for decomposing [e:, o:] into /a+i, a+u/

Other evidence argues for deriving surface [e:,o:] from /ai,au/. There is a general rule where the high vowels /i,u/ surface as the glides [j, w] before another vowel, which applies at the phrasal level in the following examples.

(27)			
	e:ti 'he comes' + ɻʂi 'seer'	→	e:tj ɻʂi
	jadi 'if' + aham 'I'	→	jadj aham
	jadi 'if' + a:ditja:h 'sons of Aditi'	→	jadj a:ditja:h
	e:ti 'she comes' + uma: 'Uma'	→	e:tj uma:
	bhawatu 'let it be' + i:çwarah 'Lord'	→	bhawatw i:çwarah
	sadhu 'well' + e:ti 'he comes'	→	sadhw e:ti

The mid vowels [e:, o:] become [aj, aw] before another vowel (an optional rule, most usually applied, can delete the glide in this context, giving a vowel sequence).

(28)			
	prabho: 'O Master' + e:ti 'he comes'	→	prabhaw e:ti
	wane: 'in the forest' + a:ste: 'he sits'	→	wanaj a:ste:
	wane: 'in the forest' + e:ti 'he comes'	→	wanaj e:ti
	prabho: 'O Master' + o:kʂat 'he sprinkled'	→	prabhaw o:kʂat

This makes perfect sense under the hypothesis that [e:,o:] derive from /ai,au/. Under that hypothesis, /wanai#a:stai/ undergoes glide formation before another vowel (just as /jadi#aham/ does), giving [wanaj#a:ste:].

Abstractness in English. Now we will consider an abstract analysis whose legitimacy has been justifiably questioned: since the main point being made here is that abstract analyses can be well motivated, it is important to consider what is *not* sufficient motivation for an abstract analysis. A classic case of questionable abstractness is the analysis of English [ɔj] proposed in Chomsky and Halle 1968 (*SPE*), that [ɔj] derives from /ɶ̄/. In *SPE*, English vowels are given a very abstract analysis, with approximately the following relations between underlying and surface representations of vowels, where /ī ū/ and so forth represent tense vowels in the transcription used there.

(29)						
	/ī/	→	[aj]	/ū/	→	[aw]
	/ē/	→	[ij]	/ō/	→	[uw]
	/ǣ/	→	[ej]	/ɔ̄/	→	[ow]
	/ɶ̄/	→	[ɔj]	/ā/	→	[ɔʌ]

The first step in arguing for this representation is to defend the assumption that [aj], [aw] [ij], [uw], [ej], [ow] derive from /ī/, /ū/, /ē/, /ō/, /ǣ/ and /ɔ̄/. The claim is motivated by the Trisyllabic Laxing alternation in English which relates the vowels of *div**i**ne* ~ *div**i**nity* ([aj] ~ [ɪ]), *prof**ou**nd* ~ *prof**u**ndity* ([aw] ~ [ə]), *ser**e**ne* ~ *ser**e**nity* ([ij] ~ [ɛ]), *verb**o**se* ~ *verb**o**sity* ([ow] ~ [ɔ]) and *s**a**ne* ~ *s**a**nity* ([ej] ~ [æ]). These word pairs are assumed to be morphologically related, so both words in the pairs would have a common root: the question is what the underlying vowel of the root is. It is assumed that tense vowels undergo a process known as Vowel Shift, which rotates a tense vowel's height one degree upward – low vowels become mid, mid vowels become high, and high vowels

become low. Another process that is relevant is Diphthongization, which inserts a glide after a tense vowel agreeing in backness with that vowel. By those rules (and a few others), /sǣn/ becomes [sējn], /serēn/ becomes [sərījn] and /divīn/ becomes [dəvajn]. By the Trisyllabic Laxing rule, when a tense vowel precedes the penultimate syllable of the word the vowel become lax, which prevents the vowel from shifting in height (shifting only affects tense vowels). Accordingly, [dəvajn] and [dəvɪnətij] share the root /dəvīn/. In [dəvajn], the tense vowel diphthongizes to [dəvījn], which undergoes Vowel Shift. In /dəvīn-iti/, the vowel /ī/ instead undergoes Trisyllabic laxing, and therefore surfaces as [ɪ].

In this way, *SPE* reduces the underlying vowel inventory of English to /ī/ /ū/ /ē/ /ī/ /ǣ/ /ā/ /ɔ̄/, plus the diphthong /ɔj/. Having eliminated most of the diphthongs from underlying representations, we are still left with one diphthong. In addition, there is an asymmetry in the inventory, that English has three out of four of the possible low tense vowels, lacking a front round vowel [œ̄]. It is then surmised that this gap in the system of tense vowels, and the remaining diphthong, can be explained away simultaneously, if [ɔj] derives from underlying /œ̄/. Furthermore, given the system of rules in *SPE*, if there were an underlying vowel /œ̄/, it would automatically become [ɔj].

Briefly, /œ̄/ undergoes diphthongization to become *ǣj* because *ǣ* is a front vowel and the glide inserted by diphthongization has the same backness as the preceding tense vowel. The vowel *ǣ* is subject to backness readjustment which makes front low vowels [+back] before glides (by the same process, *æj* which derives from /ī/ by Vowel Shift becomes [ay]). Since hypothesized /œ̄/ does not become *[ø], and must remain a low vowel in order to undergo backness adjustment, Vowel Shift must not apply to /œ̄/. This is accomplished by constraining the rule to not affect a vowel whose values of backness and roundness are different.

What constitutes a valid motivation? This analysis of [ɔj] is typical of highly abstract phonological analyses advocated in early generative phonology, where little concern was given to maintaining a close relation between surface and underlying forms. The idea of deriving [ɔj] from /œ̄/ is not totally gratuitous, since it is motivated by a desire to maintain a more symmetrical system of underlying representations. But the goal of producing symmetry in underlying representations cannot be maintained at all costs, and whatever merits there are to a symmetrical, more "elegant" underlying representational diagrams must be balanced against the fact that abstract underlying forms are inherently difficult for a child to learn. Put simply, the decision to analyze English vowels abstractly is justified only by an esoteric philosophical consideration – symmetry – and we have no evidence that this philosophical perspective is shared by the child learning the language. If achieving symmetry in the underlying form isn't a sufficient reason to claim that [ɔj] comes from /œ̄/, what would motivate an abstract analysis?

Abstractness can easily be justified by showing that it helps to account for phonological alternations, as we have seen in Palauan, Tonkawa, Matuumbi, Hehe and Sanskrit. No such advantage accrues to an abstract analysis of [ɔj] in English. The only potential alternations involving [ɔj] are a few word pairs of questionable synchronic relatedness such as *joint ~ juncture, point ~ puncture*, *ointment ~ unctious*, *boil ~ bullion, joy ~ jubilant, soil ~ sully, choice ~ choose, voice ~ vociferous, royal ~ regal*. This handful of

words gives no support to the abstract hypothesis. If underlying /œ̄/ were to undergo laxing, the result should be the phonetically nonexistant vowel [œ], and deriving the mixture of observed vowels [ʌ], [ʊ], [uw], [ow], or [ij] from [œ] would require rather ad hoc rules. The hypothesized underlying vowel system /ī ū ē ī ǣ ɔ̄ œ̄/ runs afoul of an otherwise valid implicational relation in vowel systems across languages, that the presence of a low front rounded vowel (which is one of the more marked vowels in languages) implies the presence of nonlow front round vowels. This typological implicational principle would be violated by this abstract analysis of English, which has no underlying /y, ø/: in other words, idealizations about underlying forms can conflict.

An important aspect of the argument for [ɔj] as /œ̄/ is the issue of independent motivation for the rules that would derive [ɔj]. The argument for those rules, in particular Vowel Shift, is not ironclad. Its motivation in synchronic English hinges on alternations of the type *div**i**ne* ~ *div**i**nity*, *prof**ou**nd* ~ *prof**u**ndity*, but these alternations are lexically restricted and totally unproductive in English (unlike the phonological alternations in the form of the plural suffix as well as the somewhat productive voicing alternation in *life* ~ *lives*). A consequence of the decision to analyze all cases of [aj] as deriving from /ī/ is that many other abstract assumptions had to be made to explain the presence of tense vowels and diphthongs in unexpected positions (such as before the penultimate syllable).

To account for the contrast between *contrite* ~ *contrition,* where /ī/ becomes lax and *t* → [ʃ], versus *right* ~ *righteous,* where there is no vowel laxing and *t* → [t^{ʃ}], it was claimed that the underlying form of *right* is /rixt/, and rules are developed whereby /ixC/ → [ajC]. Abstract /x/ is called on to explain the failure of Trisyllabic Laxing in the word *nightingale*, claimed to derive from /nixtVngǣl/. To explain the failure of Trisyllabic Laxing in words like *rosary*, it is assumed that the final segment is /j/ and not /i/, viz. /rɔ̄sVrj/. Other examples are that the contrast between *veto* (with no flapping and a secondary stress on [o]) vs. *motto* (with flapping and no stress on [o]) was predicted by positing different vowels – /mɔto/ vs. /vētɔ/, even though the vowel qualities are surface identical. Words such as *relevance* are claimed to contain an abstract nonhigh front glide, whose function is to trigger assibilation of /t/ and then delete, so *relevance* would derive from /relevant^{e}/, the symbol /^{e}/ representing a nonsyllabic nonhigh front vocoid (a segment not attested in any language to date).

It is not enough to just reject these analyses as being too abstract, since that circularly answers the abstractness controversy by fiat. We need to pairany such rejection with an alternative analysis that states what we *do* do with these words, and this reanalysis formed a significant component of post-*SPE* research. More importantly, we need to identify the methodological assumptions that resulted in these excessively abstract analyses. One point which emerged from this debate is that a more conservative stance on word-relatedness is called for. A core assumption in phonological analysis is that underlying representations allow related words to be derived from a unified source by rules. The concept "related word" needs to be scrutinized carefully, because liberally assuming that "related words" have common underlying forms can yield very abstract analyses.

Word relatedness. Consider word pairs such as *happy*/*glad*, *tall*/*long*, and *young*/*old*. Such words are "related," in having similar semantic properties, but they are not

morphologically related, and no one would propose deriving *happy* and *glad* from a single underlying root. Nor would anyone propose treating such pairs as *brain*/*brandy*, *pain*/*pantry*, *grain*/*grant* as involving a single underlying root, since there is no semantic relation between members of the pair. Pairs such as *five*/*punch* are related historically, but the connection is known only to students of the history of English. The words *father* and *paternal* are related semantically and phonologically, but this does not mean that we can derive *father* and *paternal* from a common root in the grammar of English. It may be tempting to posit relations between *choir* and *chorus*, *shield* and *shelter*, or *hole* and *hollow*, but these do not represent word-formation processes of modern English grammar.

The concept of "relatedness" that matters for phonology is in terms of morphological derivation: if two words are related, they must have some morpheme in common. It is uncontroversial that words such as *cook* and *cooked* or *book* and *books* are morphologically related in a synchronic grammar: the words share common roots *cook* and *book*, via highly productive morphological processes which derive plurals of nouns and past-tense forms of verbs. An analysis of word formation which failed to capture this fact would be inadequate. The relation between *tall* and *tallness* or *compute* and *computability* is similarly undeniable. In such cases, the syntactic and semantic relations between the words is transparent and the morphological processes represented are regular and productive.

Some morphological relations are not so clear: *-ment* attaches to some verbs such as *bereavement, achievement, detachment, deployment, payment, placement, allotment*, but it is not fully productive since we don't have **thinkment, *takement, *allowment, *intervenement, *computement, *givement*. There are a number of verb/noun pairs like *explain/explanation, decline/declination, define/definition, impress/impression, confuse/confusion* which involve affixation of -(*Vt*)-*ion*, but it is not fully productive as shown by the nonexistence of pairs like *contain/*contanation, refine/*refination, stress/*stression, impose/*imposion, abuse/*abusion*. Since it is not totally predictable which *-ion* nouns exist or what their exact form is, these words may just be listed in the lexicon. If they are, there is no reason why the words could not have slightly different underlying forms.

It is thus legitimate to question whether pairs such as *verbose/verbosity, profound/profundity, divine/divinity* represent cases of synchronic derivation from a single root, rather than being phonologically and semantically similar pairs of words, which are nevertheless entered as separate and formally unrelated lexical items. The question of how to judge formal word-relatedness remains controversial to this day, and with it, many issues pertaining to phonological abstractness.

9.2 Independent evidence: historical restructuring

Paul Kiparsky's seminal 1968 paper "How abstract is phonology?" raises the question whether limits on abstractness are possible and desirable. Kiparsky's concern is the postulation of segments which are never realized, where a language is assumed to have an underlying distinction between two segments that are always phonetically merged. A classic example is Hungarian, which has a vowel harmony rule where suffix vowels agree with the preceding vowel in backness, e.g. *ha:z-am* 'my house,' *fylem* 'my ear,' *vi:z-em*

'my water.' A small number of roots with the front vowels [i: i e:] always have back vowels in suffixes, e.g. *he:ɟ-am* 'my rind,' *ɲi:lam* 'my arrow.' The abstract analysis is that these roots have underlying back vowels [ɨ ɨ: ɘ:], which later become front vowels. This move makes these roots phonologically regular. The reasoning is that since these front vowels seem to act as though they are back vowels, in terms of the vowel harmony system, maybe they really *are* back vowels at a deeper level.

Kiparsky terms this kind of analysis **absolute neutralization**, to be distinguished from **contextual neutralization**. In contextual neutralization, the distinction between two underlying segments is neutralized in some contexts, but is preserved in others. Final devoicing in Russian is contextual neutralization because in the words /porok/ and /porog/, the distinction between *k* and *g* is neutralized in the nominative singular [porok], but is maintained in genitive [poroka] 'vice' vs. [poroga] 'threshold'. With absolute neutralization, the distinction is eliminated in all contexts, and thus in Hungarian, /ɨ/ is always neutralized with /i/. Kiparsky argues that while contextual neutralization is common and has demonstrable psychological reality, absolute neutralization is a theoretically constructed fiction.

In arguing against absolute neutralization, Kiparsky faces the challenge that a number of cases of such abstractness had been postulated, so good reasons for rejecting those analyses must be found. Kiparsky focuses on the extent to which the psychological reality of theoretical constructs can be measured – this is an important consideration since linguistic theories are usually intended to be models of the psychological processes underlying linguistic behavior. The problem is that it is impossible to directly test whether linguistic constructs are psychologically valid by any simple or obvious tests. Linguistic properties are highly abstract, and not easily tested in the same way that one can experimentally test the ability to perceive touch or distinguish colors or sounds. Kiparsky argues that one can, in certain circumstances, use the pattern of language change as a theory-external test of grammatical theories. It is argued that historical sound change can provide just such a test.

An abstract phonological distinction cannot be justified on the basis of the fact that two historically distinct sounds merge in the history of a language, so even if it were shown that Hungarian *he:ɟ* 'rind' and *ɲi:l* 'my arrow' derived from earlier **hə:ɟ* and **ɲɨ:l*, this would not be evidence for an abstract underlying form in modern Hungarian. A child learning the language has no access to this kind of historical information. What Kiparsky points out is that you can inspect a *later* stage of a language to learn about the analysis of a language that was actually given at an earlier stage of the language, and then adduce general principles about grammars based on such independent evidence.

9.2.1 Yiddish final devoicing

The history of Yiddish devoicing is one example of such evidence. In the oldest forms of German, represented by Old High German, there was no restriction against word-final voiced consonants, so Old High German had words like *tag* 'day' ~ *taga* 'days,' *gab* 'he gave' ~ *gābumes* 'we gave,' *sneid* 'he cut' ~ *snīdan* 'to cut,' *hand* 'hand,' *land* 'land.' Between 900 and 1200 in the Middle High German period, a rule of devoicing was

added, which resulted in *tac* ‘day’ ~ *tage* ‘days,’ *gap* ‘he gave’ ~ *gāben* ‘we gave,’ *sneit* ‘he cut’ ~ *snīden* ‘to cut,’ *hant* ‘hand’ ~ *hende* ‘hands,’ *wec* ‘road’ ~ *weges* ‘roads.’

Around this time, Yiddish began to develop as a language separate from German, and would have shared this devoicing rule. Devoicing of final consonants in Yiddish is attested in manuscripts from the thirteenth century where the word for ‘day’ is written <tak>, using the letter *kuf* [k] and not *gimel* [g]. In some dialects, such as Central and Western Yiddish, this devoicing persists up to today, where you find *tak* ‘day’ ~ *tag-n* ‘days,’ *lant* ‘land’ ~ *lend-ər* ‘lands,’ with the stem-final voiced consonants of /tag/ and /land/ undergoing final devoicing in the singular. In some dialects such as the Northeastern dialect of Yiddish, the devoicing rule was lost from the grammar, so that dialect has *tog* ‘day’ ~ *tog-n* ‘days,’ where the originally voiced consonant reappears as voiced. This process where an earlier sound change is dropped from the grammar is known as **reversal of sound change**: consonants revert to their original state found before the sound change applied.

There are mysterious exceptions to restoration of original voiced consonants. One case is the word *gelt* ‘money,’ which derives historically from *geld* with a voiced consonant. The reason for the different treatments of *gelt* and *tag*, words which both ended with voiced consonants at earlier stages of the language, is the difference in the presence or absence of phonological alternations within the paradigm of a word. In the case of *tag*, the plural form had a suffix *-n*, and so while the singular was subject to devoicing, the plural was not: this word had the paradigmatic alternations [tak] ~ [tagn]. On the basis of these alternations, a child learning the language would have no problem discovering that the underlying form of the stem is /tag/. It is expected that once the final devoicing rule is lost, the underlying form /tag/ resurfaces since there is no longer a devoicing rule.

In the word *gelt*, the situation was different. There was no inflectional ending which followed this particular noun. At the earliest stages of the language, a child learning the language only encounters [geld], and there would be no basis for assuming that the underlying form is anything other than /geld/. When the devoicing rule was added to the grammar, the pronunciation of the word changed to [gelt]. Since this particular consonant was always word-final, the devoicing rule would have always applied to it, so the stem only had the phonetic form [gelt]. Although either /geld/ or /gelt/ as underlying form would yield the surface form [gelt], there is no reason to assume that the surface and underlying forms are different. A priori criteria may support one decision or the other, but what we need to know is, what independent test tells us that our reasoning is correct? The loss of the devoicing rule provides exactly the needed empirical test: it allows us to know what underlying form Yiddish-learning children must have assumed at this earlier stage. Knowing the actual underlying form provides an important insight into the learning strategies that children make during language acquisition.

When the devoicing rule was added, there were no alternations in *gelt* so a child would have no reason to assume that the underlying form of the word is anything other than /gelt/. The child never hears *geld*, and has no reason to think that the underlying form is different from /gelt/. At an even later stage, the rule of final devoicing is dropped from the grammar of certain dialects. This allows the underlying and historically original voiced consonant of *tag* to be pronounced again, since it is no longer subject to devoicing

and thanks to the paradigmatic *k* ~ *g* alternation the underlying form was established as being /tag/. This rule loss has no effect on *gelt*, since despite being derived historically from a voiced consonant, the final consonant of the stem had been reanalyzed as /t/ – a reanalysis predicted by the presumption that an underlying form is different from the surface form only if there is good reason for assuming so. Because there are no alternations for this word, there was no reason to assume an abstract underlying form.

Another important kind of exception to the reversal of devoicing is seen in the adverb *avek* 'away.' This word was originally *aveg*, with a voiced consonant. This adverb also had no inflected relatives which allowed the underlying voicing of the final consonant to be unambiguously determined, so once the devoicing rule was added to the grammar, it was impossible to determine whether the underlying form was /avek/ or /aveg/. Again, starting from the assumption that underlying forms do not deviate from surface forms without reason, there is no reason to assume that phonetic [avek] derives from anything other than /avek/, since the word is actually pronounced [avek]. The fact that the underlying form is directly revealed as *avek* in the dialects which dropped devoicing supports this decision.

The example also reveals something interesting about what might (but does not) constitute a "reason" for abstractness. The adverb *avek* is historically related to the noun *veg* 'way.' The voicing of the last consonant in the noun stem can be recovered within the paradigm given the earlier alternations *vek* 'way' ~ *vegn* 'ways,' because the singular and plural forms of the noun are clearly related to each other. The evidence from the plural noun had no impact on the child's selection of the underlying form for the adverb, since there is no synchronic connection between the adverb and the noun – no process derives nouns and adverbs from a unified source, so nothing connects the words for 'way' and 'away.' The divergence of *veg* and *avek* in Yiddish points out that you cannot freely assume that any two phonetically and semantically similar words are actually derived from a single underlying form.

9.2.2 Historical evidence and the treatment of absolute neutralization

Kiparsky draws two main conclusions from this and similar cases. First, he points out that in lieu of alternations supporting abstractness, the surface and underlying forms should be assumed to be identical: alternations are central to supporting an abstract underlying form. Second, and more controversially, these examples are used in an argument against the psychological reality of absolute neutralization. The argument is as follows. Cases such as Yiddish show the psychological reality of contextual neutralization, since it can be reversed. However, there is no known case where absolute neutralization has been historically reversed: if absolute neutralization had the psychological reality of contextual neutralization, we would expect to find a reversal of absolute neutralization, and we have not. Therefore, putative cases of absolute neutralization lack psychological reality.

Kiparsky proposes that morphemes which seem to motivate abstract segments are simply lexical exceptions to the rule in question: they fail to undergo or trigger a rule. For the problematic roots of Hungarian where front vowels seem to trigger back harmony, such as *hɛ𝑗ː-am* 'my rind,' *𝑗ni:l-am* 'my arrow,' the proposal is that these roots are marked as exceptions to vowel harmony. On the assumption that harmonizing suffixes all contain

underlying back vowels, the fact that back vowels appear in suffixes after these roots boils down to the fact that the suffixes have underlying back vowels, and since these roots do not trigger vowel harmony the underlying vowel quality is preserved on the surface.

9.3 Well-motivated abstractness

While it is certainly true that some putative processes of absolute neutralization are not well supported and the abstract property only diacritically marks a root as an exception to one rule, there are internally well-supported cases of absolute neutralization. Two famous cases are Yawelmani discussed by Kisseberth (1969), and Maltese discussed by Brame (1972).

9.3.1 Yawelmani /u:/

Aspects of Yawelmani have been discussed in chapter 6. Two of the most important processes are vowel harmony and vowel shortening. The examples in (30) demonstrate the basics of vowel harmony: a suffix vowel becomes rounded if it is preceded by a round vowel of the same height.

(30)	*Nonfuture*	*Imperative*	*Dubitative*	*Passive aorist*	
	xat-hin	xat-k'a	xat-al	xat-it	'eat'
	dub-hun	dub-k'a	dub-al	dub-ut	'lead by hand'
	xil-hin	xil-k'a	xil-al	xil-it	'tangle'
	k'oʔ-hin	k'oʔ-k'o	k'oʔ-ol	k'oʔ-it	'throw'

Thus the root vowel /o/ has no effect on the suffixes /hin/ and /it/ but causes rounding of /k'a/ and /al/ — and the converse holds of the vowel /u/.

The data in (31) show that long vowels cannot appear before two consonants. These stems have underlying long vowels and, when followed by a consonant-initial affix, the vowel shortens.

(31)	*Nonfuture*	*Imperative*	*Dubitative*	*Passive aorist*	
	dos-hin	dos-k'o	do:s-ol	do:s-it	'report'
	ɬap-hin	ɬap-k'a	ɬa:p-al	ɬa:p-it	'burn'
	mek'-hin	mek'-k'a	me:k'-al	me:k'-it	'swallow'

Another class of verb roots has the surface pattern CVCV:C – the peculiar fact about these roots is that the first vowel is always a short version of the second vowel.

(32)	*Nonfuture*	*Imperative*	*Dubitative*	*Passive aorist*	
	p'axat-hin	p'axat-k'a	p'axa:t-al	p'axa:t-it	'mourn'
	ʔopot-hin	ʔopot-k'o	ʔopo:t-ol	ʔopo:t-it	'arise from bed'
	jawal-hin	jawal-k'a	jawa:l-al	jawa:l-it	'follow'

In [wo:ʔuj-hun], [do:lul-hun], the second vowel is epenthetic, so these roots underlyingly have the shape CV:CC, parallel to [ʔa:mil-hin] ~ [ʔamlal] 'help.'

There are problematic roots in (33). Although the stem vowel is a mid vowel, a following nonhigh vowel does not harmonize – they seem to be exceptions. Worse, a high vowel *does* harmonize with the root vowel, even though it does not even satisfy the basic phonological requirement for harmony (the vowels must be of the same height).

(33)	*Nonfuture*	*Imperative*	*Dubitative*	*Passive aorist*	
	c'om-hun	c'om-k'a	c'o:m-al	c'o:m-ut	'destroy'
	ɻog-hun	ɻog-k'a	ɻo:g-al	ɻo:g-ut	'uncork'
	wo:ʔuj-hun	wo:ʔuj-k'a	woʔj-al	woʔj-ut	'fall asleep'
	do:lul-hun	do:lul-k'a	doll-al	doll-ut	'climb'

A noteworthy property of such roots is that their vowels are always long.

There is another irregularity connected with certain surface mid vowels. The data in (34) illustrate a set of CVCVV(C) roots, where, as we noticed before, the two vowels are otherwise identical. In these verbs, the second long vowel is a nonhigh version of the first vowel.

(34)	*Nonfuture*	*Imperative*	*Dubitative*	*Passive aorist*	
	hiwet-hin	hiwet-k'a	hiwe:t-al	hiwe:t-it	'walk'
	ʔile:-hin	ʔile-k'	ʔile-l	ʔile-t	'fan'
	ɻudok'-hun	ɻudok'-k'a	ɻudo:k'-al	ɻudo:k'-ut	'remove'
	t'unoj-hun	t'unoj-k'a	t'uno:j-al	t'uno:j-ut	'scorch'
	c'ujo:-hun	c'ujo-k'	c'ujo-l	c'ujo-t	'urinate'

The surface mid vowels of these stems act irregularly for harmony – they do not trigger harmony in mid vowels, so they do not act like other mid vowels. They also exceptionally trigger harmony in high vowels, as only high vowels otherwise do.

When you consider the vowels of Yawelmani – [i e a o u e: o: a:] – you see that long high vowels are lacking in the language. The preceding mysteries are solved if you assume, for instance, that the underlying stem of the verb 'scorch' is /tunu:j/. As such, the root would obey the canonical restriction on the vowels of a bivocalic stem – they are the same vowel – and you expect /u:/ to trigger harmony on high vowels but not on mid vowels, as is the case. A subsequent rule lowers /u:/ to [o:], merging the distinction between underlying /o:/ and /u:/.

The assumption that /u:/ becomes [o:] and therefore some instances of [o:] derive from /u:/ explains other puzzling alternations. There is a vowel shortening process which applies in certain morphological contexts. One context is the causative, which adds the suffix *-a:la* and shortens the preceding stem vowel.

(35) *Nonfuture plain* *Nonfuture causative*

tis-hin	tis-a:la-hin	‘come out’
hojo:-hin	hoj-o:lo-hin	‘have a name’
mek’-hin	mik’-a:la-hin	‘eat’
c’om-hun	c’um-a:la-hin	‘destroy’

We have seen in (33) that the root [c’o:m] has the phonological characteristics of an abstract vowel, so given the surface-irregular pattern of vowel harmony in *c’om-hun, c’om-k’a* we can see that the underlying vowel must be a high vowel. The fact that the vowel actually shows up as a high vowel as a result of the morphologically conditioned shortening rule gives further support to the hypothesized abstract underlying vowel.

The approach which Kiparsky advocates for absolute neutralization does not work for Yawelmani: these words are not exceptions. Being an exception has a specific meaning, that a given morpheme fails to undergo or trigger a rule which it otherwise would undergo. The fact that vowel harmony does not apply in *c’o:m-al* can be treated as exceptionality. But this root does actually trigger vowel harmony, as shown by *c’o:m-ut*, and such application is problematic since the rule is applying when the formal conditions of the rule are not even satisfied on the surface. Marking a root as an exception says that although the root would be expected to undergo a rule, it simply fails to undergo the rule. What we have in Yawelmani is something different – a form is triggering a rule even though it should not. The exceptionality analysis also offers no account of stems such as *c’ujo:-hun*, where the first vowel should have been a copy of the second vowel but instead shows up as a high vowel; nor does the exceptionality account have any way to explain why the “exceptional” roots show up with high vowels when the root is subject to morphological vowel shortening as in *c’om-hun ~ c’um-a:la-hin*.

Although the specific segment /u:/ is not pronounced as such in the language, concern over the fact that pronunciations do not include that particular segment would be misguided from the generative perspective, which holds that language sounds are defined in terms of features and the primary unit of representation is the feature, not the segment. All of the features comprising /u:/ – vowel height, roundness, length – are observed in the surface manifestations of the abstract vowels.

9.3.2 Maltese /ʕ/

Another well-supported case of absolute neutralization comes from Maltese. We will just outline the basics of the argument: you should read Brame (1972) to understand the full argument. After outlining some basic phonological processes, we consider examples which seem superficially inexplicable, but which can be explained easily if we posit an abstract underlying consonant /ʕ/.

9.3.2.1 Basic Maltese phonology

Stress and apocope. (36) examplifies two central processes of the language, namely stress assignment and apocope. Disregarding one consonant at the end of the word, the generalization is that stress is assigned to the last heavy syllable – one that ends in a (nonfinal) consonant or one with a long vowel.

(36)	séna	‘year’	sultáan	‘king’
	ʔattúus	‘cat’	ħdúura	‘greenness’
	ħátaf	‘he grabbed’	béza ʔ	‘he spat’
	ħátf-et	‘she grabbed’	béz ʔ-et	‘she spat’
	ħtáf-t	‘I grabbed’	bzá ʔ-t	‘I spat’
	ħtáf-na	‘we grabbed’	bzá ʔ-na	‘we spat’

The second group illustrates apocope, which deletes an unstressed vowel followed by CV. The underlying stem of the word for ‘grabbed’ is /ħataf/, seen in the third-singular masculine form. After stress is assigned in third-singular feminine /ħátaf-et/, (37) gives surface [ħatf-et].

(37) $\underset{[-\text{stress}]}{\text{V}} \rightarrow \emptyset \,/\, \_\ \text{CV}$ *Apocope*

In /ħataf-t/ stress is assigned to the final syllable since that syllable is heavy (only one final consonant is disregarded in making the determination whether a syllable is heavy), and therefore the initial vowel is deleted giving [ħtáft].

Unstressed reduction and harmony. Two other rules are unstressed-vowel reduction and vowel harmony. By the former process, motivated in (38), unstressed *i* reduces to *e*. The third-singular feminine suffix is underlyingly /-it/, which you can see directly when it is stressed. The underlying form of *kíteb* is /kitib/. When stress falls on the first syllable of this root, the second syllable reduces to *e*, but when stress is final, the second syllable has *i*.

(38)	hátf-et	‘she grabbed’	ħatfít-kom	‘she grabbed you (pl)’
	béz ʔ-et	‘she spat’	bez ʔ-ít-l-ek	‘she spat at you’
	kíteb	‘he wrote’	ktíb-t	‘I wrote’

Thus the following rule is motivated.

(39) $\underset{[-\text{stress}]}{\text{i}} \rightarrow [-\text{hi}]$ *Unstressed V-reduction*

By vowel harmony, /i/ becomes [o] when preceded by *o*.

(40)	kórob	‘he groaned’	kórb-ot	‘she groaned’
	ʃórob	‘he drank’	ʃórb-ot	‘she drank’

Surface *kórb-ot* derives from /korob-it/ by applying stress assignment, the vowel harmony in (41), and apocope.

(41) $\text{i} \rightarrow [+\text{round}] \,/\, \underset{[+\text{round}]}{\text{V}}\ \text{C}_0\ \_$ *Harmony*

Epenthesis. The data in (42) illustrate another rule, which inserts [i] before a word-initial sonorant that is followed by a consonant.

(42)	láʔat	‘he hit’	róħos	‘it (masc) became cheap’
	láʔt-et	‘she hit’	róħs-ot	‘it (fem) became cheap’
	ilʔát-t	‘I hit’	irħós-t	‘I became cheap’
	ilʔát-na	‘we hit’	irħós-na	‘we became cheap’
	márad	‘he became sick’	néfaħ	‘he blew’
	márd-et	‘she became sick’	néfħ-et	‘she blew’
	imrád-t	‘I became sick’	infáħ-t	‘I blew’
	imrád-na	‘we became sick’	infáħ-na	‘we blew’

Stress assignment and apocope predict /laʔat-na/ → *lʔát-na*: the resulting consonant cluster sonorant plus obstruent sequence is eliminated by the following rule:

(43) Ø → i / # _ [+ sonor] C *Epenthesis*

Regressive harmony and precoronal fronting. These rules apply in the imperfective conjugation, which has a prefix *ni-* ‘1st person,’ *ti-* ‘2nd person’ or *ji-* ‘3rd person’ plus a suffix *-u* ‘plural’ for plural subjects. The underlying prefix vowel *i* is seen in the following data:

(44)	ní-msaħ	‘I wipe’	tí-msaħ	‘you wipe’
	ní-ʃbaħ	‘I resemble’	tí-ʃbaħ	‘you resemble’
	ní-kteb	‘I write’	tí-kteb	‘you write’
	ní-tlef	‘I lose’	tí-tlef	‘you lose’

When the first stem vowel is *o*, the prefix vowel harmonizes to *o*:

(45)	nó-bzoʔ	‘I spit’	tó-bzoʔ	‘you spit’
	nó-krob	‘I groan’	tó-krob	‘you groan’
	nó-ħlom	‘I dream’	tó-ħlom	‘you dream’
	nó-ʔtol	‘I kill’	tó-ʔtol	‘you kill’
	nó-rbot	‘I tie’	tó-rbot	‘you tie’
	nó-lʔot	‘I hit’	tó-lʔot	‘you hit’

This can be explained by generalizing harmony (41) so that it applies before or after a round vowel. The nature of the stem-initial consonant is important in determining whether there is surface harmony; if the first consonant is a coronal obstruent, there appears to be no harmony.

(46)	ní-drob	‘I wound’	tí-drob	‘you wound’
	ní-tlob	‘I pray’	tí-tlob	‘you pray’
	ní-skot	‘I become silent’	tí-skot	‘you become silent’
	ní-zloʔ	‘I slip’	tí-zloʔ	‘you slip’
	ní-ʃrob	‘I drink’	tí-ʃrob	‘you drink’

Examples such as *nó-bzoʔ* show that if the coronal obstruent is not immediately after the prefix vowel, harmony applies. The explanation for apparent failure of harmony is simply that there is a rule fronting *o* when a coronal obstruent follows.

(47) $o \rightarrow [-back] / \_ \begin{bmatrix} +cor \\ -son \end{bmatrix}$

Guttural lowering. Another process lowers /i/ to *a* before the "guttural" consonants *ʔ* and *ħ*:

Treating glottal stop as [+low] is controversial since that contradicts the standard definition of [+low], involving tongue lowering. Recent research in feature theory shows the need for a feature that includes laryngeal glides in a class with low vowels and pharyngeal consonants.

(48)				
	ná-ʔsam	'I divide'	tá-ʔsam	'you divide'
	ná-ʔbel	'I agree'	tá-ʔbel	'you agree'
	ná-ħrab	'I flee'	tá-ħrab	'you flee'
	ná-ħleb	'I milk'	tá-ħleb	'you milk'

This motivates the following rule:

(49) $i \rightarrow [+ low] / \_ \begin{matrix} C \\ [+ low] \end{matrix}$ *guttural lowering*

Metathesis. (50) and (51) illustrate another process. When the stem has a medial obstruent, the prefix vowel is stressed and the stem vowel deletes before *-u*.

(50)				
	ní-msaħ	'I wipe'	ní-msħ-u	'we wipe'
	nó-bzoʔ	'I spit'	nó-bzʔ-u	'we spit'
	ní-dħol	'I enter'	ní-dħl-u	'we enter'
	ná-ʔsam	'I divide'	ná-ʔsm-u	'we divide'
	ná-ħdem	'I work'	ná-ħdm-u	'we work'

This is as expected: underlying /ni-msaħ-u/ is stressed on the first syllable, and the medial unstressed vowel deletes because it is followed by CV. The example [nóbzʔu] from /ni-bzoʔ-u/ shows that harmony must precede apocope, since otherwise apocope would have deleted the stem vowel which triggers harmony.

When the second stem consonant is a sonorant, in the presence of the suffix *-u* the prefix has no stress, and the stem retains its underlying vowel, which is stressed. Unstressed *i* reduces to [e], so [ní-dneb] derives from /ni-dnib/. The underlying high vowel is revealed with the stem vowel is stressed, as in [nidínbu].

(51)				
	ní-dneb	'I sin'	ni-dínb-u	'we sin'
	ní-tlef	'I lose'	ni-tílf-u	'we lose'

ní-tlob	‘I pray’	ni-tólb-u	‘we pray’
nó-krob	‘I groan’	no-kórb-u	‘we groan’
nó-ʔmos	‘I kick’	no-ʔóms-u	‘we kick’
ná-ħrab	‘I flee’	na-ħárb-u	‘we flee’
ná-ħraʔ	‘I burn’	na-ħárʔ-u	‘we burn’
ná-ʔleb	‘I overturn’	na-ʔílb-u	‘we overturn’

Based solely on stress assignment and apocope, as illustrated in (50), we would predict **nídnbu*, **nótlbu*. This again would result in an unattested consonant cluster in the syllable onset – a sonorant followed by an obstruent – which is avoided by a process of vocalic metathesis whereby *ní-tlif-u* → *ni-tílf-u*.

(52) V C C V_i C V → V C V_i C C V *Metathesis*
[+ son]

In some stems which undergo (52), the vowel alternates between *i* and *a*:

(53)	ní-fraħ	‘I rejoice’	ni-fírħ-u	‘we rejoice’
	ní-tlaʔ	‘I leave’	ni-tílʔ-u	‘we leave’
	ní-sraʔ	‘I steal’	ni-sírʔ-u	‘we steal’

The underlying stem vowel is /i/ in these cases. When no vowel suffix is added, underlying /ni-friħ/ becomes [ní-fraħ] by Guttural Lowering (49). When *-u* is added, metathesis moves underlying /i/ away from the guttural consonant which triggered lowering, hence the underlying vowel is directly revealed.

Stems with long vowels. The stems which we have considered previously are of the underlying shape CVCVC. There are also stems with the shape CVVC, illustrated in the perfective aspect in (54):

(54)	dáar	‘he turned’	sáar	‘it (masc) grew ripe’
	dáar-et	‘she turned’	sáar-et	‘it (fem) grew ripe’
	dáar-u	‘they turned’	sáar-u	‘they grew ripe’
	dór-t	‘I turned’	sír-t	‘I became ripe’
	dór-na	‘we turned’	sír-na	‘we became ripe’
	dór-tu	‘you turned’	sír-tu	‘you became ripe’

These stems exhibit a process of vowel shortening where *aa* becomes *o* or *i* (the choice is lexically determined) before a CC cluster.

(55) aa → i,o / _ CC

When the imperfective prefixes *ni-*, *ti-* are added to stems beginning with a long vowel, stress is assigned to that vowel and the prefix vowel is deleted. In the case of the first-person prefix /ni/, this results in an initial nC cluster, which is repaired by inserting the vowel *i*.

(56)	in-dúur	‘I turn’	in-síir	‘I become ripe’
	t-dúur	‘you turn’	t-síir	‘you become ripe’
	in-súuʔ	‘I drive’	in-zíid	‘I add’
	t-súuʔ	‘you drive’	t-zíid	‘you add’

From /ni-duur/, you expect stress to be assigned to the final syllable because of the long vowel. Since the vowel of /ni/ is unstressed and in an open syllable, it should delete, giving *ndúur*. The resulting cluster then undergoes epenthesis.

9.3.2.2 Apparent irregularities. A number of verbs seem to be irregular, and yet they are systematic in their irregularity: the irregularity is only in terms of the surface form, which can be made perfectly regular by positing an abstract underlying consonant /ʕ/. One set of examples is seen in the data in (57), where the stem contains a surface long vowel. This long vowel is unexpectedly skipped over by stress assignment, unlike verbs with underlying long vowels such as *in-dúur* ‘I turn’ seen in (56).

(57)	ní-sool	‘I cough’	ni-sóol-u	‘we cough’
	ní-laab	‘I play’	ni-láab-u	‘we play’
	ní-baat	‘I send’	ni-báat-u	‘we send’
	nó-ʔood	‘I stay’	no-ʔóod-u	‘we stay’
	nó-bood	‘I hate’	no-bóod-u	‘we hate’

The location of stress and the retention of the prefix vowel in *nó-ʔood* is parallel to the retention of the prefix vowel in other tri-consonantal stems in (44)–(48), such as *ní-msaħ* ‘I wipe.’ If the underlying stem of *ní-sool* had a consonant, i.e. were /sXol/ where X is some consonant yet to be fully identified, the parallelism with *ni-msaħ* and the divergence from *in-dúur* would be explained. The surface long vowel in *nísool* would derive by a compensatory lengthening side effect coming from the deletion of the consonant X in /ní-sXol/.

Another unexpected property of the stems in (57) is that when the plural suffix *-u* is added, the prefix vowel is stressless and unelided in an open syllable, and the stress shifts to the stem, e.g. *ni-sóol-u* ‘we cough.’ Thus, contrast *ni-sóol-u* with *ní-msħ-u* ‘we wipe,’ which differ in this respect, and compare *ni-sóol-u* to *ni-ʃórb-u* ‘we drink,’ which are closely parallel. Recall that if the medial stem consonant is a sonorant, expected V-CRC-V instead undergoes metathesis of the stem vowel around the medial consonant, so /ni-ʃrob-u/ becomes *ni-ʃórb-u* (creating a closed syllable which attracts stress). If we hypothesize that the underlying stem is /sXol/, then the change of /ni-sXol-u/ to *ni-sóXl-u* (phonetic *nisóolu*) would make sense, and would further show that X is a sonorant consonant: ʕ qualifies as a sonorant (it involves minimal constriction in the vocal tract).

Another pecularity is that these long vowels resist shortening before CC:

(58)	sóol	‘he coughed’	sóolt	‘I coughed’	sóolna	‘we coughed’
	sóob	‘he lamented’	sóobt	‘I lamented’	sóobna	‘we lamented’
	ʔáad	‘he stayed’	ʔáadt	‘I stayed’	ʔáadna	‘we stayed’

báad	‘he hated’	báadt	‘I hated’	báadna	‘we hated’

In contrast to examples in (54) such as *dáar* ‘he turned,’ *dór-t* ‘I turned’ with vowel shortening before CC, these long vowels do not shorten. Continuing with the hypothesis of an abstract consonant in /soXol/, we explain the preservation of the long vowel in [sóolt] if this form derives from *sXol-t*, where deletion of X (which we suspect is specifically ʕ) lengthens the vowel, and does so after vowel shortening has applied.

There is a further anomaly in a subset of stems with the consonant X in the middle of the root: if the initial stem consonant is a sonorant, epenthetic *i* appears when a consonant-initial suffix is added. Compare (59a) where the first consonant is not a sonorant with (59b) where the first consonant is a sonorant.

(59)	a.	ʔáad	‘he stayed’	ʔáadt	‘I stayed’
		báad	‘he hated’	báadt	‘I hated’
		sóol	‘he coughed’	sóolt	‘I coughed’
	b.	máad	‘he chewed’	imáadt	‘I chewed’
		náas	‘he dozed’	ináast	‘I dozed’
		láaʔ	‘he licked’	iláaʔt	‘I licked’

The verbs in (59b) behave like those in (42), e.g. *láʔat* ‘he hit’ ~ *ilʔát-t* ‘I hit’ where the initial sonorant + C cluster undergoes epenthesis of *i*. The forms in (59b) make sense on the basis of the abstract forms *máʕad* ~ *mʕádt*, where the latter form undergoes vowel epenthesis and then the consonant ʕ deletes, lengthening the neighboring vowel. Before ʕ is deleted, it forms a cluster with the preceding sonorant, which triggers the rule of epenthesis.

Other mysteries are solved by positing this consonant in underlying forms. In (60), the first stem consonant appears to be a coronal obstruent. We have previously seen that when the stem-initial consonant is a coronal, obstruent vowel harmony is undone (*ní-tlob* ‘I pray’), so (60) is exceptional on the surface. In addition, the prefix vowel is unexpectedly long, whereas otherwise it has always been short.

(60)	nóodos	‘I dive’	tóodos	‘you dive’
	nóodʒob	‘I please’	tóodʒob	‘you please’
	nóotor	‘I stumble’	tóotor	‘you stumble’

These forms are unexceptional if we assume that the initial consonant of the stem is not *d, dʒ, t*, but the abstract consonant ʕ, thus /ʕdos/, /ʕdʒob/, /ʕtor/: ʕ is not a coronal obstruent, so it does not cause fronting of the prefix vowel.

Other examples provide crucial evidence regarding the nature of this abstract consonant. The data in (61) show a lengthened prefix vowel, which argues that the stems underlyingly have the initial abstract consonant that deletes and causes vowel lengthening: [náalaʔ] comes from /ni-ʕlaʔ/.

(61)	náalaʔ	‘I close’	táalaʔ	‘you close’

náasar	'I squeeze'	táasar	'you squeeze'
náaraʃ	'I tickle'	táaraʃ	'you tickle'

In addition, the quality of the prefix vowel has changed from /i/ to [aa], even though in these examples the consonant which follows on the surface is a coronal. If the abstract consonant is a pharyngeal as we have hypothesized, then the vowel change is automatically explained by the Guttural Lowering rule.

We have considered stems where the first and second root consonants are the consonant ʕ: now we consider root-final ʕ. The data in (62) show examples of verbs whose true underlying imperfective stems are CCV.

(62)				
	ná-ʔra	"I read"	ná-ʔra-w	'we read'
	ní-mla	'I fill'	ní-mla-w	'we fill'

The plural suffix /u/ becomes [w] after final *a*. Although the second consonant is a sonorant, the metathesis rule does not apply in *náʔraw* because no cluster of consonants containing a sonorant in the middle would result.

Now compare verbs with a medial sonorant where the final consonant is hypothesized /ʕ/. The singular columns do not have any striking irregularities which distinguish them from true CVCV stems.

(63)				
	ní-sma	'I hear'	ni-síma-w	'we hear'
	ní-zra	'I sow'	ni-zíra-w	'we sow'
	ní-bla	'I swallow'	ni-bíla-w	'we swallow'
	ná-ʔla	'I earn'	na-ʔíla-w	'we earn'

The prefix vowel is unstressed and in an open syllable, which is found only in connection with metathesis: but metathesis is invoked only to avoid clusters with a medial sonorant, which would not exist in hypothetical *[níblau]. This is explained if the stem ends with /ʕ/. Thus /ni-smiʕ-u/ should surface as *nisímʕu*, by analogy to /ni-tlob-u/ → [nitólbu] 'we ask.' The consonant /ʕ/ induces lowering of the vowel *i*, and ʕ itself becomes *a*, giving the surface form.

A final set of examples provides additional motivation for assuming underlying ʕ. Participles are formed by giving the stem the shape CCVVC, selecting either *ii* or *uu*. As the data in (64) show, stems ending in the consonant /ʕ/ realize that consonant as [ħ] after long high vowels.

(64)						
	ʔátel	'he killed'	ʔtíil	'killing'	maʔtúul	'killed'
	ħátaf	'he grabbed'	ħtíif	'grabbing'	maħtúuf	'grabbed'
	fétaħ	'he opened'	ftíiħ	'opening'	miftúuħ	'opening'
	téfa	'he threw'	tfíiħ	'throwing'	mitfúuħ	'thrown'
	bála	'he swallowed'	blíiħ	'swallowing'	miblúuħ	'swallowed'
	ʔála	'he earned'	ʔlíiħ	'earning'	maʔlúuħ	'earned'

These data provide evidence bearing on the underlying status of the abstract consonant, since it actually appears on the surface as a voiceless pharyngeal in (64). Although the forms of the participials [ftíiħ] and [tfiiħ] are analogous, we can tell from the inflected forms [fétaħ] 'he opened' versus [téfa] 'he threw' that the stems must end in different consonants. The most reasonable assumption is that the final consonant in the case of [téfa] is some pharyngeal other than [ħ], which would be [ʕ]. Thus, at least for verb stems ending in /ʕ/, the underlying pharyngeal status of the consonant can be seen directly, even though it is voiceless. Since the abstract consonant can be pinned down rather precisely in this context, we reason that in all other contexts, the abstract consonant must be /ʕ/ as well.

The crucial difference between these examples of abstractness and cases such as putative /ɨ/ and /ə/ in Hungarian, or deriving [ɔj] from /œ̄/ in English, is that there is strong language-internal evidence for the abstract distinction /u:/ vs. /o:/ in Yawelmani, or for the abstract consonant /ʕ/ in Maltese.

9.4 Grammar-external evidence for abstractness

Yawelmani and Maltese provide well-motivated abstract analyses, based on patterns of alternation in the grammar. We would still like to find grammar-external evidence that abstract analyses can be psychologically valid, analogous to the historical arguments which Kiparsky adduced from the history of Yiddish and other languages in support of the more surface-oriented approach to phonology.

9.4.1 Abstract analysis and historical change: Tera

One such argument for the psychological reality of abstract analysis comes from Tera. Newman 1968 provides a synchronic and diachronic argument for abstract phonology, where similar surface forms have different underlying forms.

The synchronic argument. Data in (65) illustrate a basic alternation. Some nouns ending in [i] in their citation forms lack that vowel in phrase medial contexts:

(65)	na **seɗi**	'this is a snake'	na **seɗ** ɓa	'this is not a snake'
	na **deɓi**	'this is gum'	na **deɓ** ɓa	'this is not gum'
	dala wa **wuɗi**	'Dala pointed'		
	dala wa **wuɗ** koro	'Dala pointed at the donkey'		
	dala wa **mbuki**	'Dala threw'		
	dala wa **mbuk** koro	'Dala threw at the donkey'		

Not all words ending in [i] prepausally engage in this alternation, as the data in (66) demonstrate:

(66)	na **wuɗi**	'this is milk'	na **wuɗi** ɓa	'this is not milk'
	a **saɓi**	'this is a stick'	na **saɓi** ɓa	'this is not a stick'

Given a vowel ~ Ø alternation plus a set of stems which are invariantly *i*-final in (66), we might be led to surmise that the stems in (65) are C-final, and take an epenthetic vowel [i] phrase-finally. This can be ruled out given (67), where the stem ends in a consonant both phrase-medially and phrase-finally.

(67)	na **ruf**	'this is a baboon'	na **ruf** ɓa	'this is not a baboon'
	tin **zoɓ**	'she is a slob'	tin **zoɓ** ɓa	'she is not a slob'
	na **ɓoŋ**	'this is white'	na **ɓoŋ** ɓa	'this is not white'

A completely surface-oriented account where the underlying form must be one of the surface variants is untenable: the nouns in (65) have a variant with the vowel [i], but selecting /i/ for the underlying form fails to distinguish (65) from (66) which always have [i]; and the nouns of (65) also have a variant with no final vowel, but the nouns in (67) *always* lack a final vowel.

Other roots of the variable-final type give evidence that the problematic stems in (65) underlyingly end in schwa. The data in (68) provide monosyllabic words which have the shape *Ci* prepausally and *Cə* phrase medially.

(68)	dala wa **ɮi**	'Dala received'
	dala wa **ɮə** sule	'Dala received a shilling'
	dala wa **ɗi**	'Dala went'
	dala wa **ɗə** goma	'Dala went to the market'

These words contrast with ones that have invariant [i] in both contexts.

(69)	dala wa **ɮi**	'Dala paid'
	dala wa **ɮi** sule	'Dala paid a shilling'
	dala wa **vi**	'Dala roasted'
	dala wa **vi ɮu**	'Dala roasted meat'

For the stems in (68), an obvious nonabstract solution is available: the stems end with /ə/, and there is a rule turning schwa into [i] prepausally:

(70) ə → i / _ ##

This applies in *dala wa **ɗi*** 'Dala went' from *dala wa **ɗə***, but final schwa is unaffected in *dala wa **ɗə** goma* 'Dala went to the market.' The stems in (69) do not alternate since they end in the vowel /i/. This solution is nonabstract since the underlying form, /ɗə/, is one of the observed surface variants.

There are other stems with final [i] prepausally and [ə] phrase medially.

(71)	na **pərsi**	'this is a horse'
	na **pərsə** ɓa	'this is not a horse'
	dala wa **kədi**	'Dala pulled'
	dala wa **kədə** koro	'Dala pulled a donkey'

These stems either have the shape [CVCCə] phrase-medially, or else [CVZə] where Z is a plain-voiced consonant (not implosive).

This gives the following groups of stems with an underlying final schwa:

(72)	*Stem shape*	*Medial*	*Prepausal*
	Cə	Cə	Ci
	CVCCə	CVCCə	CVCCi
	CVZə	CVZə	CVZi
	CVCə	CVC	CVCi

For most of these stems, postulating underlying schwa is quite concrete, since schwa actually surfaces in phrase-medial context. However, in polysyllabic stems such as *deɓi ~ deɓ* with a single voiceless consonant before final schwa, the analysis is abstract because schwa is never phonetically manifested in the morpheme. The decision that the vowel in question is schwa is based on analogy with a known behavior of schwa: it becomes [i] prepausally.

Our analysis requires a rule which deletes word-final phrase-medial schwa, provided that the stem is polysyllabic and ends only in a single voiceless consonant.

This rule presupposes that only non-implosive obstruents in Tera are [+voice] since only they are distinctively voiced. Any [+voice] specification on sonorants and implosives is redundant, predictable from the features [+sonorant] or [+c.g.].

(73) $\text{ə} \rightarrow \emptyset \;/\; \text{V} \quad \underset{[-\text{ voice}]}{\text{C}} \quad \_\,\#\,\ldots$

Further evidence supports abstract schwa in certain words. The examples in (74a) show that when a vowel *-a* marking definite nouns is suffixed to a stem such as /pərsə/ which ends in schwa, schwa deletes, whereas underlying /i/ is not deleted. The data in (74b) show the same thing with the imperative suffix /u/:

(74)					
	a.	pərsi ← /pərsə/	‘horse’	pərs-a	‘the horse’
		wudɗi	‘milk’	wudɗi-a	‘the milk’
	b.	vi	‘to roast’	vi-u	‘roast!’
		dɗi ← /dɗə/	‘to go’	dɗ-u	‘go!’
		kədi ← /kədə/	‘to pull’	kəd-u	‘pull!’
		mbuki ← /mbukə/	‘to throw’	mbuk-u	‘throw!’

This motivates a rule of prevocalic schwa deletion, which provides another diagnostic that differentiates schwa from /i/.

(75) $\text{ə} \rightarrow \emptyset \;/\; \_\;\text{V}$

Although ‘throw’ only has the surface variants [mbuki] ~ [mbuk], it behaves exactly like stems such as /kədə/ where schwa is phonetically realized, and acts unlike /vi/, in losing its final vowel before another vowel. Finally, there is an allomorphic variation in the form of the adjective suffix *-kandi*, which shows up as *-kandi* when the stem ends in a vowel (*saɓir taɗa-kandi* ‘heavy stick’) and as *-ndi* when the stem ends in a consonant (*saɓir teɓer-ndi* ‘straight stick’). The stem of the word for ‘long’ ends in abstract schwa, since it alternates between final [i] (*saɓira kəri* ‘the stick is long’) and medial Ø (*saɓira kər ɓa* ‘the stick is not long’). Furthermore, the stem selects the postvocalic variant of the adjective suffix (*saɓir kər-kandi* ‘long stick’), even though on the surface the stem ends with a consonant and not a vowel. This anomaly is explained by the hypothesis that the stem does in fact end in a vowel, namely schwa. Thus multiple lines of argument establish the presence of an abstract vowel schwa in a number of words in the synchronic grammar of Tera.

The diachronic argument. A recent sound change in Tera provides a grammar-external test of the abstract hypothesis. In one dialect of Tera, spoken in the town of Zambuk, a rule was added which palatalized *t*, *d* and *d* to *tʃ*, *dʒ* and *dᶻ* before *i*. The dialect of Tera spoken in Wuyo is representative of the rest of Tera, in retaining the original alveolars. Thus we find Wuyo *da*, Zambuk *da* ‘one’ with no palatalization, but Wuyo *di*, Zambuk *dʒi* ‘to get up’ where *d* palatalizes. There are synchronic alternations which further motivate this palatalization process in the contemporary grammar of the Zambuk dialect, so where the Wuyo dialect has *xat-a*‘my brother,’ *xat-in* ‘his brother,’ the Zambuk dialect has *xat-a*, *xatʃ-in*. In Wuyo one finds *wudî* ‘milk’ and in Zambuk one finds *wudᶻi* , deriving from /wudi/ – that the final vowel is /i/ and not /ə/ is shown by the phrase medial form *wudî*.

While palatalization is active in the Zambuk dialect, it does not affect all surface sequences of alveolar plus [i], in particular it does not affect [i] which derives from schwa. In the Wuyo dialect ‘to pull’ is *kədi* before pause, *kədə* medially (cf. *dala wa kədə koro* ‘Dala pulled a donkey’), and therefore we know that the stem is /kədə/. In the Zambuk dialect, the medial form is also *kədə*, showing that the stem ends in schwa in that dialect, and the prepausal form is *kədi*. Thus palatalization does not apply to the output of final schwa-fronting: the failure of palatalization to apply to this derived [di] sequence provides another diagnostic of the distinction between /i/ and [i] derived from /ə/.

Further confirming our hypothesis about abstract schwa, the stem /wudə/ ‘to point’ which appears in the Wuyo dialect as *wudî* prepausally and as *wud* medially (*dala wa wud koro* ‘Dala pointed at a donkey’) appears as *wudî* in the Zambuk dialect, without palatalization, as is regularly the case with the vowel [i] derived from /ə/. The fact that the innovative sound change of palatalization found in the Zambuk dialect is sensitive to the sometimes abstract distinction between underlying /i/ versus ones derived from schwas, especially when the schwa never surfaces, supports the claim that abstract underlying forms can be psychologically real.

9.4.2 Abstract reanalysis in Matuumbi NC sequences

Other evidence for abstract phonology comes from a historical reanalysis of postnasal consonants in the Bantu language Matuumbi. Nouns in Bantu are composed of a prefix

plus stem, and the prefix changes between singular and plural. For example, proto-Bantu *mu-ntu* 'person' contains the class 1 prefix *mu-* marking certain singular nouns, and the plural *ba-ntu*'people' contains the class 2 prefix *ba-*. Different nouns take different noun-class prefixes (following the tradition of historical linguistics, reconstructed forms are marked with an asterisk).

(76)	*Proto-Bantu sg*	*Class*	*Proto-Bantu pl*	*Class*	
	*mʊ-ntʊ	1	*ba-ntʊ	2	'person'
	*mʊ-gʊnda	3	*mɪ-gʊnda	4	'field'
	*li-tako	5	*ma-tako	6	'buttock'
	*m-paka	9	*dim-paka	10	'cat'
	*lʊ-badu	11	*dim-badu	10	'rib'

A postnasal voicing rule was added in the proto-Rufiji-Ruvuma subgroup of Bantu (a subgroup which includes Matuumbi), so that original **mpaka* 'cat' came to be pronounced *mbaka* in this subgroup.

(77)		*Proto-Bantu*	*Matuumbi*	
		*mpaka	mbaka	'cat'
		*ŋkaŋga	ŋgaaŋga	'guinea fowl'
		*ntembo	ndeembo	'elephant'
		*mʊntʊ	muundu	'person'
		*ŋkʊŋgʊnɪ	ŋguuŋguni	'bedbug'
	cf.	*mbabada	mbabala	'bushbuck'
		*mbʊdi	mbwi	'goat'
		*mbʊa	mbwa	'dog'

Another inconsequential change is that the class 10 prefix, originally **din-*, lost *di*, so the class 10 prefix became completely homophonous with the class 9 prefix.

In the Nkongo dialect of Matuumbi, there was a change in the morphological system so that nouns which were originally assigned to classes 9–10 now form their plurals in class 6, with the prefix *ma-*. Earlier **ŋaambo* 'snake ~ snakes' now has the forms *ŋáambo* 'snake' / *ma-ŋáambo* 'snakes.'

Given surface [mbwa] 'dog' (proto-Bantu **m-bʊa*) originally in classes 9–10, the concrete analysis is that the underlying form in proto-Rufiji is /m-bwa/. It was always pronounced as [mbwa], since the root was always preceded by a nasal prefix. The absence of alternations in the phonetic realization of the initial consonant would give reason to think that phonetic [b] derives from underlying /b/. By the same reasoning, we predict that earlier *mpaka* 'cat' is reanalyzed as /b/, once the word came to be pronounced as *mbaka* in all contexts: compare Yiddish *gelt*.

The restructuring of the morphological system of Nkongo Matuumbi where the original class pairing 9–10 is reanalyzed as 9–6 allows us to test this prediction, since nouns with

their singulars in class 9 no longer have a nasal final prefix in all forms; the plural has the prefix *ma-*. As the following data show, the concrete approach is wrong.

(78)	*Proto-Bantu*	*Matuumbi sg*	*Original pl*	*Innovative pl*	
	*m-pembe	m-beembe	m-beembe	ma-peembe	‘horn’
	*ŋ-kʊkʊ	ŋ-guku	ŋ-gʊkʊ	ma-kuku	‘chicken’
	*m-bʊa	m-bwa	m-bwa	ma-pwa	‘dog’
	*m-babada	m-babala	m-babala	ma-pabala	‘bushbuck’
	*m-bʊdi	m-bwi	m-bwi	ma-pwi	‘goat’
	*m-baŋgo	m-baaŋgo	m-baaŋgo	ma-paaŋgo	‘warthog’
	*m-bʊtʊka	m-bʊtʊka	m-bʊtʊka	ma-pʊtʊka	‘antelope’

While the distinction /mp/ ~ /mb/ was neutralized, it was neutralized in favor of a phonetically more abstract consonant /p/ rather than the concrete consonant /b/.

This reanalysis did not affect all nouns which had a singular or plural in classes 9–10; it affected only nouns which originally had both their singulars and plurals in this class, i.e. only those nouns lacking alternation. Nouns with a singular in class 11 and a plural in class 10 preserve the original voicing of the consonant.

(79)	*Proto-Bantu*	*Matuumbi sg*	*Matuumbi pl*	
	*m-badu	lu-bau	m-bau	‘rib’
	*n-godi	lu-goi	ŋ-goi	‘rope’
	*n-dɪmi	lu-lɪmi	n-dɪmi	‘tongue’
	*ŋ-kʊŋgʊnɪ	lu-kuuŋguni	ŋ-guuŋguni	‘bedbug’
	*n-tondʊa	lu-toondwa	n-doondwa	‘star’

A word such as ‘rib’ always had a morphological variant which transparently revealed the underlying consonant, so the contrast between /n-toondwa/ → [ndoondwa] and /n-goi/ → [ŋgoi] was made obvious by the singulars [lu-toondwa] and [lu-goi].

While it is totally expected that there should be a neutralization of **mp* and **mb* in words like *mbaka, mbwa* – there would have been no evidence to support a distinction between surface [mb] deriving from /mb/ versus [mb] deriving from /mp/ – surprisingly from the viewpoint of concrete phonology, the direction of neutralization where [mb] is reanalyzed as /mp/ is unexpected. One explanation for this surprising reanalysis regards the question of markedness of different consonants. Given a choice between underlying /m + b/ and /m + p/, where either choice would independently result in [mb], one can make a phonetically conservative choice and assume /m + b/, or make a choice which selects a less marked consonant, i.e. /m + p/. In this case, it is evident that the less marked choice is selected where the choice of consonants is empirically arbitrary.

Such examples illustrating phonetically concrete versus abstract reanalyses motivated by considerations such as markedness are not well enough studied that we can explain why language change works one way in some cases, and another way in other cases. In the

case of Yiddish *avek* from historically prior *aveg*, there would be no advantage at all in assuming underlying /aveg/, from the perspective of markedness or phonetic conservatism.

9.4.3 Language games and Bedouin Arabic

Language games can also provide evidence for the mental reality of underlying representations. Their relevance is that language game modifications are not always performed on the surface form, so by modifying the phonetic environment in which segments appear in the language, games may cause rules to apply when they would not normally (providing evidence for the reality of the phonological process), or prevent a rule from applying when it normally would (revealing the abstract underlying form). An example of such evidence comes from Bedouin Arabic spoken in Saudi Arabia, discussed by Al-Mozainy 1981. A number of verbs have the underlying form /CaCaC/, but this analysis is abstract in that, for these verbs, the first vowel sequence is never found on the surface, and the root surfaces as [CiCaC].

9.4.3.1 Regular language phonology. We begin by motivating aspects of the phonology of the language, especially underlying representations, using regular language data. Verb stems may have different underlying vowels, but the passive is formed by systematically replacing all underlying vowels with /i/. Underlying /i/ deletes in an open syllable, as shown by the following data:

(80)	*3sg masc*	*3sg fem*	*1sg*	
	ħzim	ħizm-at	ħzim-t	'be tied'
	ħfir	ħifr-at	ħfir-t	'be dug'
	ʃrib	ʃirb-at	ʃrib-t	'be drunk'
	ʕzim	ʕizm-at	ʕzim-t	'be invited'
	lbis	libs-at	lbis-t	'be worn'

Taking underlying /ħizim/ and /ħizim-t/ as examples, the vowel /i/ in the first syllable is in an open syllable, so the rule of high-vowel deletion applies, giving [ħzim] and [ħzimt]. In the case of /ħizim-at/, both vowels *i* are in an open syllable: the second *i* deletes, which makes the first syllable closed, so the first vowel does not delete resulting in [ħizmat]. The following rule is motivated by (80).

(81) $i \rightarrow \emptyset$ / _ CV *high-vowel deletion*

Now we consider another class of nonpassive verbs, where the underlying stem shape is CaCiC. In these stems, the second vowel shows up as *i* when there is no vowel after the stem. The first vowel of the stem alternates between [i] and [a], surfacing as [i] when the second vowel appears as [i], otherwise surfacing as [a]. Examples of verbs with this vocalic pattern are seen in (82):

(82) *3sg masc* *3sg fem* *1sg*

simiʕ	samʕ-at	simiʕ-t	‘hear’
libis	labs-at	libis-t	‘wear’
ʃirib	ʃarb-at	ʃirib-t	‘drink’
jibis	jabs-at	jibis-t	‘become dry’
silim	salm-at	silim-t	‘save’
liʕib	laʕb-at	liʕib-t	‘play’
ħilim	ħalm-at	ħilim-t	‘dream’

In underlying /samiʕ-at/, the vowel /i/ is in an open syllable so it deletes, giving [samʕat]. In /samiʕ/ and /samiʕ-t/, final /i/ does not delete since it is not in an open syllable, and /a/ assimilates to [i] before [i], by the following harmony rule:

(83) a → i / _ C i

This creates a surface [i] in an open syllable which does not undergo deletion.

Now we turn to stems with the underlying shape /CaCaC/. In a number of such verbs this representation is uncontroversial since that is how it surfaces.

(84)

3sg masc	*3sg fem*	*1sg*	
gaʕad	gʕad-at	gaʕad-t	‘sit’
waʕad	wʕad-at	waʕad-t	‘promise’
tˁaʕan	tˁʕan-at	tˁaʕan-t	‘stab’
saħab	sħab-at	saħab-t	‘pull’
tˁaħan	tˁħan-at	tˁaħan-t	‘grind’
daxal	dxal-at	daxal-t	‘enter’
naxal	nxal-at	naxal-t	‘sift’

Examples such as [gʕadat] from /gaʕad-at/ illustrate the application of another rule, one deleting /a/ when followed by CVCV.

(85) a → Ø / _ CVCV

An important fact about the stems in (84) is that the second consonant is a guttural (*x, ɣ, ħ, h, ʕ* or *ʔ*). There is a dissimilative process in the language turning /a/ into [i] in an open syllable if the next vowel is /a/, providing that the vowel is neither preceded nor followed by a guttural consonant. In the above examples, the consonant in the middle of the stem is a guttural, so neither the first nor the second vowels can undergo the dissimilative raising rule. Now consider the data in (86), where the first consonant is a guttural but the second is not.

(86)

3sg masc	*3sg fem*	*1sg*	
ʕazam	ʕzim-at	ʕazam-t	‘invite’
ħazam	ħzim-at	ħazam-t	‘tie’
hakam	hkim-at	hakam-t	‘rule’

This verbal restriction on the consonant next to the target vowel goes beyond what is allowed in the version of the formal theory presented here. How such conditions are to be incorporated into an analysis has been the subject of debate.

Here the first vowel of the stem cannot become [i] because of the preceding consonant, but the second vowel does dissimilate to [i] when followed by /a/, and thus /ʕazam-at/ becomes [ʕzimat] (with deletion of the first vowel by (85)). This rule is separate from the harmony rule that turns /a/ into [i] before [i], because harmony applies irrespective of the flanking consonants, cf. [ħilim] 'he dreamt.'

(87) a → i / _ C a (target is not adjacent to a guttural consonant)

In [ʕazam] and [ʕazamt], there is no dissimilation because the first consonant is guttural, which prevents the following /a/ from undergoing dissimilation.

Examples in (88) show the same restriction on dissimilation of the second vowel /a/, which does not become [i] when the last consonant is a guttural.

(88)	*3sg masc*	*3sg fem*	*1sg*	
	difaʕ	dfaʕ-at	difaʕ-t	'push'
	rˤikaʕ	rˤkaʕ-at	rˤikaʕ-t	'bend'
	xadaʕ	xdaʕ-at	xadaʕ-t	'cheat'

Another consonantal property inhibiting dissimilation is a coronal sonorant. In this case, if the two vowels are separated by any of /n, r, l/, there is no dissimilation. In the examples of (89), the first vowel is prevented from dissimilating because it is preceded by a guttural. In addition, the second stem vowel is prevented from dissimilating because it is separated from suffixal /a/ by a coronal sonorant. Therefore, both underlying stem vowels remain unchanged.

(89)	*3sg masc*	*3sg fem*	*1sg*	
	ħafar	ħfar-at	ħafar-t	'dig'
	ħamal	ħmal-at	ħamal-t	'carry'
	ɣasal	ɣsal-at	ɣasal-t	'wash'

In the examples of (90), the first vowel is followed by a consonant other than a coronal sonorant, and is neither preceded nor followed by a guttural, so it dissimilates to [i]. The second vowel is followed by a coronal sonorant, so there is no dissimilation in the second syllable.

(90)	*3sg masc*	*3sg fem*	*1sg*	
	nizal	nzal-at	nizal-t	'get down'
	sikan	skan-at	sikan-t	'occupy'
	kisar	ksar-at	kisar-t	'break'
	difan	dfan-at	difan-t	'bury'

nital	ntal-at	nital-t	‘steal’
ʃitar	ʃtar-at	ʃitar-t	‘divide’

In (91) we find verbs with a coronal sonorant as the second consonant. The second vowel /a/ dissimilates before *a*, since the intervening consonant is neither guttural nor a coronal sonorant. The preceding coronal sonorant has no effect on dissimilation, since unlike the effect of gutturals, coronal sonorants only have an effect if they stand after the target vowel.

(91)	*3sg masc*	*3sg fem*	*1sg*	
	dʒalas	dʒlis-at	dʒalas-t	‘sit’
	garʕasʕ	grʕisʕ-at	garʕasʕ-t	‘sting’
	garʕatʕ	grʕitʕ-at	garʕatʕ-t	‘throw’
	sarag	srig-at	sarag-t	‘steal’
	balas	blis-at	balas-t	‘denounce’
	ʃanag	ʃnig-at	ʃanag-t	‘hang’
	daras	dris-at	daras-t	‘study’

Finally, verbs with no gutturals or coronal sonorants are given in (92).

(92)	*3sg masc*	*3sg fem*	*1sg*	
	kitab	ktib-at	kitab-t	‘write’
	misak	msik-at	misak-t	‘catch’
	sikat	skit-at	sikat-t	‘stop talking’
	nitaf	ntif-at	nitaf-t	‘pluck’
	gisam	gsim-at	gisam-t	‘divide’
	giðab	gðib-at	giðab-t	‘catch’
	nikas	nkis-at	nikas-t	‘retain’

By the deletion rule (85), underlying /katabat/ becomes *ktabat*, which becomes [ktibat] by dissimilation. In /katab-t/, since the first vowel is not followed by CVCV it cannot elide, and it dissimilates to [i] before [a] in the second syllable.

The vowel /a/ in the second syllable of verbs like [kitab] is only mildly abstract, since it does surface as [a] as long as the syllable is not open. The initial /a/, the syllable on the other hand, is fully abstract since there is no context in this verb where the underlying /a/ appears as such in these verbs, and instead the vowel only appears as [i]. However, we know that the initial vowel cannot be /i/, since if it were, that vowel would delete in an open syllable – contrast active [kitab] and [kitabt] from /katab/ and /katab-t/, with the passives [ktib] and [ktibt] from /kitib/ and /kitib-t/.

The occurrence of initial nondeleting [i] in an open syllable is entirely predictable. It appears when neither the first nor second stem consonant is a guttural, and when the second stem consonant is not a coronal sonorant. This nondeleting [a] is thus in

complementary distribution with surface [a] (which nonabstractly derives from underlying /a/), which only appears when one of the first two consonants is a guttural or the second consonant is a coronal sonorant.

Hence there is strong language-internal motivation for claiming that the initial vowel of stems such as [kitab] is underlyingly /a/, and is subject to dissimilation to [i] or deletion.

9.4.3.2 Language game evidence. There is a language game used by speakers of Arabic which provides independent evidence for the mental reality of these rules and underlying representations. The rule for the language game is very simple: permute the order of consonants within the root. Now let us consider the various phonetic results of permutation on the verb forms *ħazam* 'he tied' and *ħzim-at* 'she tied.' In *ħazam*, the first vowel does not dissimilate because of the preceding guttural; in *ħzimat* the second stem vowel dissimilates because it is neither preceded nor followed by a gutural, and it is not followed by a coronal sonorant.

(93)	'he tied'	'she tied'	
	ħamaz	ħmizat	~
	zaħam	zħamat	~
	zimaħ	zmaħat	

In the permuted forms *ħamaz* and *ħmizat*, where the second and third consonants have exchanged place, the vocalic pattern remains the same because the transposition has not crucially changed the consonantal environment.

Now consider the forms *zimaħ* ~ *zmaħat*. This pattern of transposition has two effects on the vowel pattern. First, because the first consonant is now not a guttural, the dissimilation rule can apply in the first syllable, demonstrating the reality of the dissimilation rule. Second, because the final consonant is now a guttural, the dissimilation rule cannot apply in the second syllable, demonstrating the reality of the blocking condition on dissimilation. Finally, in the case of *zaħam* ~ *zħamat*, because the medial consonant is a guttural, neither vowel can dissimilate.

A crucial example, in terms of testing the validity of the proposed /CaCaC/ underlying form for surface [CiCaC] stems, is a stem such as /dafaʕ/ 'push,' which surfaces as [difaʕ]. Such a supposed underlying representation is abstract, since the vowel of the first syllable always surfaces as [i] or Ø, cf. *difaʕ* 'he pushed,' *dfaʕat* 'she pushed,' never as *a*. This stem contains a final pharyngeal consonant, and therefore movement of that consonant to first or second position will put the first vowel in contact with a pharyngeal. This should then block dissimilation, and will directly reveal the hypothesized underlying vowel to be [a].

(94)	'he pushed'	'she pushed'	
	fidaʕ	fdaʕat	~
	daʕaf	dʕafat	~
	ʕadaf	ʕdifat	~

ʕafad ʕfidat

The fact that this vowel actually surfaces as [a] under the circumstances predicted by the abstract hypothesis gives strong support to the claim for an abstract representation of such stems as having the vowel pattern /CaCaC/.

9.5 How abstract is phonology?

On the one hand we have argued for abstract analyses of Matuumbi, Yawelmani, Maltese and other languages; but we have argued against abstract analyses of English. The reason for this apparently inconsistent view of abstractness is that abstractness per se is not the issue; the proper question to be focusing on is what motivates an analysis. Thus we conclude that the formal theory of grammar imposes no constraints on the relation between underlying and surface forms, though the theory does state what kinds of elements can exist in underlying representations: phonetically interpretable combinations of features, i.e. segments.

This does not mean that highly abstract underlying representations can be gratuitously assumed. Underlying representations require motivation: they must be acquired by children learning the language, and the best assumption to make is that in lieu of evidence to the contrary, underlying and surface forms are identical. The question that needs further investigation is, what constitutes valid "evidence to the contrary"? Phonological alternations in the shape of a morpheme provide very powerful evidence for abstractness. It remains an open question whether other considerations are also valid in constructing an underlying form.

Although we have focused on the relation between underlying and surface forms, the larger question which this debate raises is, what counts as valid evidence for testing a phonological theory. It has proven extremely difficult to resolve questions about the psychological reality of theorized linguistic constructs. Two approaches, both valid, have been taken. One is the "domain-internal" approach, where formal constraints are proposed to the effect that (for example) underlying forms should be a subpart of an actually pronounced word in the language, or underlying forms should only contain segments actually pronounced in the language. We cannot show that these claims are literally "wrong": what we can do is show that such a position renders us incapable of capturing important generalizations about the phonologies of Maltese and Yawelmani, for example.

The other approach, the "domain-external" approach, seeks evidence from outside the domain of synchronic phonological grammars themselves, in an attempt to find independent evidence that answers the question of what is actually in the mind of the speaker. Any number of such approaches can be imagined – neurosurgery, psycholinguistic testing, language games, historical change, the study of language acquisition, and so on. Such evidence is extremely hard to find in the first place: virtually all relevant experimental work is conducted on a tiny handful of commonly spoken languages, which typically do not have internally well-motivated abstractness. Additionally, the experimental methodology must be critically evaluated, which is usually very difficult to do outside of one's own discipline. Finally the evidence must be

interpreted against a general theory of, for example, child developmental psychology. The question of how to empirically validate theory-internal hypotheses remains very much an open question in phonology, as it is in all scientific domains.

Exercises

1 Slovak

The focus of this problem is the underlying representation of diphthongs. Discuss the underlying status of diphthongs in Slovak, based on these data. Nouns in Slovak come in three genders, which determines what suffix if any is used in the nominative singular: masculines have no suffix, feminines have *-a*, and neuters have *-o*.

A. There is a process of lengthening which takes place in certain morphological contexts, including the genitive plural and the diminutive.

Nom sg	*Gen pl*	
lipa	li:p	‘linden tree’
muxa	mu:x	‘fly’
lopata	lopa:t	‘shovel’
sr̩na	sr̩:n	‘deer’
ʒena	ʒien	‘woman’
kazeta	kaziet	‘box’
hora	huor	‘forest’
sirota	siruot	‘orphan’
pæta	piat	‘heel’
mæta	miat	‘mint’
kopito	kopi:t	‘hoof’
bruxo	bru:x	‘belly’
blato	bla:t	‘mud’
salto	sa:lt	‘somersault’
embargo	emba:rg	‘embargo’
jabl̩ko	jabl̩:k	‘apple’
koleso	kolies	‘wheel’
lono	luon	‘lap’
hovædo	hoviad	‘beast’
vla:da	vla:d	‘government’
blu:za	blu:z	‘blouse’
dla:to	dla:t	‘chisel’
vi:no	vi:n	‘vine’
tʃiara	tʃiar	‘line’

hniezdo	hniezd	‘nest’
noun	*diminutive*	
hrad	hra:dok	‘castle’
list	li:stok	‘leaf’
xl̩p	xl̩:pok	‘hair’
kvet	kvietok	‘flower’
hovædo	hoviadok	‘beast’

B. There is also a shortening rule that applies in certain morphological contexts, including the imperfective of verbs and the comparative of adjectives.

Perfective	*Imperfective*	
odli:sit^{j}	odlisovat^{j}	‘to distinguish’
ku:pit^{j}	kupovat^{j}	‘to buy’
ohla:sit^{j}	ohlasovat^{j}	‘to announce’
predl̩:ʒit^{j}	predl̩zovat^{j}	‘to extend’
oblietat^{j}	obletovat^{j}	‘to fly around’
uviazat^{j}	uvæzovat^{j}	‘to bind’
adjective	*comparative*	
bli:ski	bliʃʃi:	‘near’
u:ski	uʃʃi:	‘narrow’
kra:tki	kratʃi:	‘short’
bieli	belʃi:	‘white’
rietki	retʃi:	‘rare’

C. There is an alternation in the form of case suffixes which is governed by properties of the stem which precedes

Nom sg	*Gen sg*	*Nom pl*	*Dat pl*	*Loc pl*	
mesto	mesta	mesta:	mesta:m	mesta:x	‘town’
blato	blata	blata:	blata:m	blata:x	‘mud’
hovædo	hovæda	hovæda:	hovæda:m	hovæda:x	‘town’
pi:smeno	pi:smena	pi:smena:	pi:smena:m	pi:smena:x	‘letter’
za:meno	za:mena	za:mena:	za:mena:m	za:mena:x	‘pronoun’
dla:to	dla:ta	dla:ta	dla:tam	dla:tax	‘town’
vi:no	vi:na	vi:na	vi:nam	vi:nax	‘wine’
hniezdo	hniezda	hniezda	hniezdam	hniezdax	‘nest’

D. The rule that explains the alternations in C also explains why a rule motivated by the data in A seems not to have applied.

Nom sg	*Gen pl*	
za:hrada	za:hrad	‘garden’
ni:ʒina	ni:ʒin	‘hollow’
za:toka	za:tok	‘inlet’
pi:smeno	pi:smen	‘letter’
za:meno	za:men	‘pronoun’
lietʃivo	lietʃiv	‘drug’

E. Some stems underlyingly end with consonant clusters, and undergo a process of vowel epenthesis that eliminates certain kinds of consonant clusters.

Nom sg	*Gen pl*		
ikra	ikier	‘roe’	(cf. also *ikernati*: ‘abounding in roe’)
ihla	ihiel	‘needle’	
dogma	dogiem	‘dogma’	
sosna	sosien	‘pine tree’	
bedro	bedier	‘hip’	
radlo	radiel	‘plow’	
hradba	hradieb	‘rampart’	
doska	dosiek	‘board’	
kri:dlo	kri:del	‘wing’	
tʃi:slo	tʃi:sel	‘number’	
pa:smo	pa:sem	‘zone’	
vla:kno	vla:ken	‘fiber’	
pla:tno	pla:ten	‘linen’	

2 Urhobo

Account for the phonological alternations in the following data. Tone can be ignored. The diacritic underneath a vowel indicates that the vowel is [+ATR] (“Advanced Tongue Root”), and vowels without the diacritic are [-ATR].

sị̀	‘pull’	ẹ̀sjọ́	‘to pull’	ụ́rụ̀hɾé	‘rope’	sj ụ́rụ̀hɾé	‘pull a rope’
fị̀	‘spray’*	ẹ̀fjọ́	‘to spray’	ẹ́wụ́	‘clothes’	fj ẹ́wụ́	‘spray clothes’
kụ̀	‘pour’	ẹ̀kwọ́	‘to pour’	ẹ̀βɾì	‘oil’	kw ẹ̀βɾì	‘pour oil’
rụ̀	‘do’	ẹ̀rwọ́	‘to do’	ẹ́zẹ̀kè	‘dedication’	rw ẹ́zẹ̀kè	‘do a dedication’
sẹ̀	‘call’	ẹ̀sẹ́	‘to call’	óʃàɾẹ̀	‘man’	s óʃàɾẹ̀	‘call a

							man’
mẹ̀	‘plait’	ẹ̀mẹ́	‘to plait’	écọ́	‘hair’	m écọ́	‘plait hair’
cọ̀	‘steal’	ẹ̀cọ́	‘to steal’	ẹ́kpṵ̀	‘bag’	c ẹ́kpṵ̀	‘steal a bag’
φè	‘urinate’	èφé	‘to urinate’	ẹ̀gọ́	‘bottle’	φ ẹ̀gọ́	‘fill a bottle’
ʃè	‘sell’	èʃé	‘to sell’	ẹ̀ŋmá	‘clothes’	ʃ ẹ̀ŋmá	‘sell clothes’
hwè	‘laugh’	èhwé	‘to laugh’	ómó	‘child’	hw ómó	‘laugh at a child’
vɛ̃̀	‘expose’	èvɛ̃́	‘to expose’			v ɔ̃́mó	‘expose a child’
gbɛ̃̀	‘clear’	ègbɛ̃́	‘to clear’	áγwá	‘forest’	gb ã́γwá	‘clear a forest’
tɛ̃̀	‘be worthless’	ègbɛ̃́	‘to be worthless’				
kɔ̃̀	‘plant’	èkɔ̃́	‘to plant’	ị̀rí̩bọ́	‘pepper’	k ị̀rí̩bọ́	‘plant pepper’
γò	‘worship’	èγó	‘to worship’	ị̀ní̩	‘elephant’	γ ị̀ní̩	‘worship elephant’
sà	‘shoot’	èsá	‘to shoot’	ọ̀hwọ́	‘person’	s ọ̀hwọ́	‘shoot a person’
hwà	‘pay’	èhwá	‘to pay’			hw ọ̀hwọ́	‘pay a person’
γɛ̃̀	‘be foolish’	ẹ̀γɛ̃́	‘to be foolish’				
φɛ̃̀	‘be wide	ẹ̀φɛ̃́	‘to be wide’				
βjè	‘bear’	ẹ̀βjé	‘to bear’	ómó	‘child’	βj ómó	‘bear a child’
rẹ̀	‘eat’	èrjó	‘to eat’	òné	‘yam’	rj òné	‘eat yam’
sɛ̃̀	‘reject’	èsj̃ó	‘to reject’	ẹ̀fẹ̀	‘wealth’	sj̃ ẹ̃́fẹ̀	‘reject wealth’
cọ̀	‘trade’	ècwó	‘to trade’	ẹ̀rẹ́	‘mat’	cw ẹ̀rẹ́	‘trade a mat’
sọ̀	‘sing’	èswó	‘to sing’	ṵ̀nẹ̀	‘song’	sw ṵ̀nẹ̀	‘sing a song’

*“spray” refers to lavish gift-giving.

mɨ̨sɨ̀wɛ̀	ǒsɨ̀βɛ̀	mɨ̀sɨ́rɨ̀	ǒsɨ́rɨ̀	mɨ̌ʒɨ́sjè	ǒʒɨ́sjè	mɨ̀sɨ́rǒ	‘pull’
mɨ̌fɨ̀wɛ̀	ǒfɨ̀βɛ̀	mɨ̀fɨ́rɨ̀	ǒfɨ́rɨ̀	mɨ̌ʒɨ́fjè	ǒʒɨ́fjè	mɨ̀fɨ́rǒ	‘spray’
mɨ̀kʊ̀wɛ̀	ǒkʊ̀βɛ̀	mɨ̀kʊ́rʊ̀	ǒkʊ́rʊ̀	mɨ̌ʒɨ́kwè	ǒʒɨ́kwè	mɨ̀kʊ́rǒ	‘pour’
mɨ̌rʊ̀wɛ̀	ǒrʊ̀βɛ̀	mɨ̀rʊ́rʊ̀	ǒrʊ́rʊ̀	mɨ̌ʒɨ́rwè	ǒʒɨ́rwè	mɨ̀rʊ́rǒ	‘do’
mɨ̌sɛ̀wɛ̀	ǒsɛ̀βɛ̀	mɨ̀sɛ́rɨ̀	ǒsɛ́rɨ̀	mɨ̌ʒɨ́sɛ̀	ǒʒɨ́sɛ̀	mɨ̀sɛ́rǒ	‘call’
mɨ̌mɛ̀wɛ̀	ǒmɛ̀βɛ̀	mɨ̀mɛ́rɨ̀	ǒmɛ́rɨ̀	mɨ̌ʒɨ́mɛ̀	ǒʒɨ́mɛ̀	mɨ̀mɛ́rǒ	‘plait’
mɨ̌cʊ̀wɛ̀	ǒcʊ̀βɛ̀	mɨ̀cʊ́rɨ̀	ǒcʊ́rɨ̀	mɨ̌ʒɨ́cʊ̀	ǒʒɨ́cʊ̀	mɨ̀cʊ́rǒ	‘steal’
mɛ̌φèwè	ǒφèβè	mɛ̀φérɛ̀	òφérɛ̀	mɛ̌ʒɛ́φè	ǒʒɛ́φè	mɛ̀φéró	‘urinate on’
mɛ̌ʃèwè	ǒʃèβè	mɛ̀ʃérɛ̀	òʃérɛ̀	mɛ̌ʒɛ́ʃè	ǒʒɛ́ʃè	mɛ̀ʃéró	‘sell’
mɛ̌hwèwè	ǒhwèβè	mɛ̀hwérɛ̀	òhwérɛ̀	mɛ̌ʒɛ́hwè	ǒʒɛ́hwè	mɛ̀hwéró	‘laugh’
mɛ̌vɛ̃wè	ǒvɛ̃βè	mɛ̀vɛ̃rɛ̀	òvɛ̃rɛ̀	mɛ̌ʒɛ́vɛ̃	ǒʒɛ́vɛ̃	mɛ̀vɛ̃ró	‘expose’
mɛ̌gbɛ̃wè	ǒgbɛ̃βè	mɛ̀gbɛ̃rɛ̀	ògbɛ̃rɛ̀	mɛ̌ʒɛ́gbɛ̃	ǒʒɛ́gbɛ̃	mɛ̀gbɛ̃ró	‘clear’
mɛ̌tɛ̃	ǒtɛ̃	mɛ̀tɛ̃rɛ̀	òtɛ̃rɛ̀	mɛ̌ʒɛ́tɛ̃	ǒʒɛ́tɛ̃		‘be worthless’
mɛ̌kɔ̃wè	ǒkɔ̃βè	mɛ̀kɔ̃rɛ̀	òkɔ̃rɛ̀	mɛ̌ʒɛ́kɔ̃	ǒʒɛ́kɔ̃	mɛ̀kɔ̃ró	‘plant’
mɛ̌γòwè	ǒγòβè	mɛ̀γórɛ̀	òγórɛ̀	mɛ̌ʒɛ́γò	ǒʒɛ́γò	mɛ̀γóró	‘worship’
mɛ̌sàwè	ǒsàβè	mɛ̀sárɛ̀	òsárɛ̀	mɛ̌ʒɛ́sà	ǒʒɛ́sà	mɛ̀sáró	‘shoot’
mɛ̌hwàwè	ǒhwàβè	mɛ̀hwárɛ̀	òhwárɛ̀	mɛ̌ʒɛ́hwà	ǒʒɛ́hwà	mɛ̀hwáró	‘pay’
mɨ̌ɣɛ̃̀	ǒɣɛ̃̀	mɨ̀ɣɛ̃́rɨ̀	ǒɣɛ̃́rɨ̀	mɨ̌ʒɨ́ɣɛ̃̀	ǒʒɨ́ɣɛ̃̀		‘be foolish’
mɨ̌φɛ̃̀	ǒφɛ̃̀	mɨ̀φɛ̃́rɨ̀	ǒφɛ̃́rɨ̀	mɨ̌ʒɨ́φɛ̃̀	ǒʒɨ́φɛ̃̀		‘be wide’
mɨ̌βjèwɛ̀	ǒβjèβɛ̀	mɨ̀βjérɨ̀	ǒβjérɨ̀	mɨ̌ʒɨ́βjè	ǒʒɨ́βjè	mɨ̀βjéró	‘bear’
mɛ̌rɛ̀wè	ǒrɛ̀βè	mɛ̀rɛ́rɛ̀	òrɛ́rɛ̀	mɛ̌ʒɛ́rjà	ǒʒɛ́rjà	mɛ̀rɛ́ró	‘eat’
mɛ̌sɛ̃̀wè	ǒsɛ̃̀βè	mɛ̀sɛ̃́rɛ̀	òsɛ̃́rɛ̀	mɛ̌ʒɛ́sj̃ɑ̃̀	ǒʒɛ́sj̃ɑ̃̀	mɛ̀sɛ̃́ró	‘reject’
mɛ̌cʊ̀wè	ǒcʊ̀βè	mɛ̀cʊ́rʊ̀	òcʊ́rʊ̀	mɛ̌ʒɛ́cwà	ǒʒɛ́cwà	mɛ̀cʊ́ró	‘trade’
mɛ̌sʊ̀wè	ǒsʊ̀βè	mɛ̀sʊ́rʊ̀	òsʊ́rʊ̀	mɛ̌ʒɛ́swà	ǒʒɛ́swà	mɛ̀sʊ́ró	‘sing’
‘I V (you)’	‘she Vs (me)’	‘I V-ed’	‘she V-ed’	‘I am still	‘she is	‘I have V-ed	
				V-ing’	still V-ing’	him’	

Further reading

Chomsky and Halle 1968; Hudson 1974; Hyman 1970; Kiparsky 1968; Sapir 1933.