

Phonemic analysis

Morpheme: pairing of sound ↔ meaning.

- Meaningful subpart of a word.
- **Cannot be broken up** into smaller meaningful subparts.

unaffected [ʌn - [əfekt - ɪd]]
NEGATIVE - [affect - ADJECTIVE]

loveliness [[lʌv - li] - nɪs]
[love - ADJECTIVE] - NOUN

- **Comprehension question:** How would you break the word *regeneration* into nested morphological units?

Word: one or more *morphemes*, which can stand alone as a full utterance.

Q: How do you feel?

A: Unimpressed.

Q: Do you feel impressed?

A: *Un-.

PHONEMIC ANALYSIS

Some major components of phonological analysis:

Phonetic inventories: what surface phonetic sounds are observed in the language?

- English: [sɪŋ] *sing*
- Spanish: [iŋkluir] 'to include'

Phonotactics: what constitutes a possible word/morpheme (in language X)?

○ Central focus: **restrictions on possible combinations of sounds.**

- Georgian (Kartvelian, Georgia): [p^ht^hɪla] 'lock of hair'
- English: [p^hɪl] *peel*
[t^hɪl] *teal*
*[p^ht^hɪl] *pteel* Compare: *pterodactyl* [t^hɜədæktəl]

○ *Christmas* [k^hɪsmɪs] > Japanese [ku^hɾis^hmasu]

Phonemics: what phonetic differences between words/morphemes can *lead to a difference in meaning* (in language X)?

Phonemic contrast

Two sounds are **contrastive** in a given language if the difference between those two sounds – and *only* those two sounds – can lead to a difference in meaning between words.

English: the difference between [n] and [ŋ] is contrastive.

[sɪŋ] *sing*

[sɪn] *sin*

Spanish: the difference between [n] and [ɲ] is *not* contrastive.

[ablan] ≈ [ablaɲ] ‘they speak’

Another example: [n ɲ]

- English: [mæn] *man* vs. [mʌnθ] *month*

[tɛn] *ten* vs. [tɛnθ] *tenth*

[tɛn] ≈ [tɛɲ] *ten*

- Mapudungun (Chile): [mɪna] ‘enough’ vs. [mɪɲa] ‘paternal male cousin’

One more example: [d ɾ]

- English: [æd] *add* vs. [æɾɪŋ] *adding*

[æɾɪŋ] ≈ [ædɪŋ] *adding*

- Japanese: [dokɯ] ‘poison’ vs. [rokɯ] ‘six’

How do we show that two sounds are contrastive?

Key concept: **Minimal pairs.**

- Two words which differ in meaning.
- Phonetically identical *except* for a single segment in a specific position.
- Makes clear *which* phonetic differences can cause a difference in meaning.

Are the following minimal pairs?

- (1) *race* ~ *raise* (2) *take* ~ *lake* (3) *crane* ~ *grate*
 (4) *breath* ~ *breathe* (5) *rain* ~ *ram* (6) *rule* ~ *fool*

Can you think of any minimal triplets? Any larger sets of minimal pairs?

Some more complicated examples:

- (1) *all* [al] ~ *mall* [mal] (2) *billow* ['bɪloʊ] ~ *below* [bə'loʊ]

Tagalog (Austronesian, Philippines): [h] and [ʔ]

kahon	‘box’	ʔari	‘property’
hariʔ	‘king’	kaʔon	‘to fetch’
ʔumagos	‘to flow’	humagos	‘to paint’

Distributions and contrast

Contrastive sounds occur in **at least some of the same environments** – that’s why minimal pairs are possible.

[sɪŋ] *sing* [sɪn] *sin*

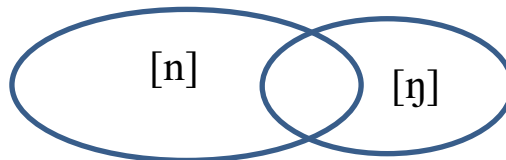
Important note: in phonology, we define the *environment* of a sound on the basis of sounds to the immediate left and right.

[sɪŋ] *sing*:

- Environment for [s] = # _ ɪ (# = word boundary)
- Environment for [ɪ] = s _ ŋ
- Environment for [ŋ] = ɪ _ #

However, contrastive sounds don’t necessarily occur in *all* of the same environments.

[nɑɪs] *nice* *[ɲɑɪs] *ngice*
 *[smk] *sink* [smk] *sink*



Contrastive sounds have an **overlapping** distribution.

- Also known as **contrastive distribution**.

CONTEXTUAL VARIATION

Sometimes, **the same basic sound has different phonetic realizations** depending on the context it occurs in.

This can be seen most clearly with **alternations** -- changes in the basic form of a morpheme depending on its context.

Note: alternation,
not alteration.

- English:
 - [tɛn] *ten* vs. [tɛn̩θ] *tenth* [n] ~ [n̩]
 - [æd] *add* vs. [ærɪŋ] *adding* [d] ~ [r]
 - ['æɾəm] *atom* vs. [ə'tʰəmɪk] *atomic* [ɾ] ~ [tʰ], [æ] ~ [ə]
- Kaqchikel (Mayan, Guatemala):
 - [ʃ - in - 'sɔk] 'I cut it' vs. [sɔk - a - 'neɭ] 'barber' [ɔ] ~ [o]

We use the notation "A ~ B" to indicate **variation in the phonetic form** of a single sound or morpheme depending on its context (= an **alternation**).

Alternations are **not random** - they depend *systematically* on properties of each sound's environment:

Negative in- on adjectives (*in-x* = 'not X')

[ɪn-]	[ɪm-]	[ɪŋ-]
in - tolerable	im - possible	in - complete
in - tractable	im - polite	in - correct
in - tangible	im - perfect	in - compatible
in - terminable	im - patient	in - coherent
in - describable	im - balanced	in - consistent
in - divisible		in - gracious
in - distinct		

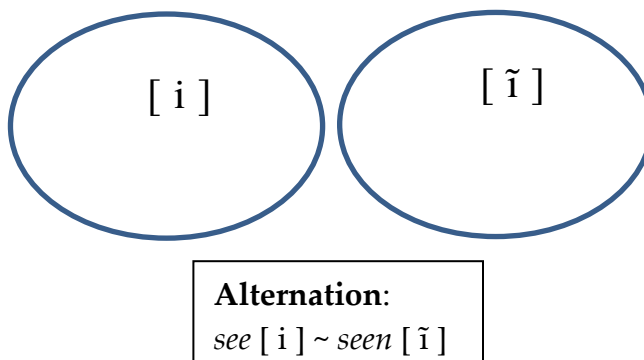
- Using the IPA, list the environments that each variant of the prefix *in-* occurs in. For example, the environment for *incomplete* would be [# __ k] in the IPA.
- Do we **see any generalizations** about where each variant of the prefix occurs?
- Does it make sense that we find the variants [ɪn-], [ɪm-], and [ɪŋ-] in each of these phonetic environments?

Contextual variants of the same sound occur in **non-overlapping environments**.

- Variant X occurs **predictably** in environment A
- Variant Y occurs **predictably** in a different environment B

Vowel nasalization in English:

[i]	[ĩ]
seed [sid]	seen [sĭn]
seat [sit]	seem [sĭm]
leak [lik]	team [t ^h ĭm]
seep [sip]	mean [mĭn]
meek [mik]	keen [k ^h ĭn]
sneeze [sniz]	lean [lĭn]
beef [bif]	bean [bĭn]



Basic method

- Write out the environment that each sound [i] and [ĩ] occurs (in the data).
- Check whether or not they are overlapping.
- If not, describe the environment that each sound occurs in.

When two sounds are **contextual variants** of the same sound, they are **non-contrastive**.

[bin] ≈ [bĭn] *bean*

[bĭf] ≈ [bif] *beef*

CONTRAST, DISTRIBUTIONS, AND PREDICTABILITY

Sounds that are **contrastive** belong to **different phonemes**.

- **Phonemes**: the 'basic' contrastive speech sounds in a given language.
- Minimal pairs help establish the **phonemic inventory** - the set of basic contrastive sounds - for a particular language.

[sŋ] <i>sing</i>	[sm] <i>sin</i>	→	/n/	/ŋ/
[sp] <i>sip</i>	[st] <i>sit</i>		/p/	/t/
[sk] <i>sick</i>	[sl] <i>sill</i>		/k/	/l/ ...

- We use slash brackets /X/ to indicate phonemes (basic sounds).

When sounds are **contrastive**, their distribution is **unpredictable** - they occur in the same environments.

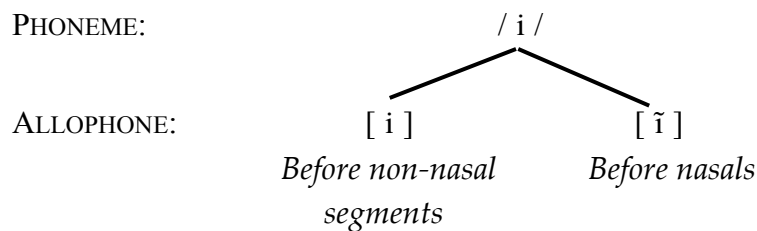
- | | | |
|--------------------------|--------------------------|---------------------------|
| (1) <i>pin</i> [] | (2) <i>tin</i> [] | (3) <i>kin</i> [] |
| (4) <i>bin</i> [] | (5) <i>din</i> [] | (6) <i>shin</i> [] |
| (7) <i>sin</i> [] | (8) <i>fin</i> [] | (9) <i>thin</i> [] |

When sounds are **contextual variants of the same basic sound**, we call them **allophones of the same phoneme**.



- We use square brackets [X] to indicate allophones (contextual variants).

Allophones of the same phoneme are **not contrastive**, and their distribution is **predictable**.



Contextual (allophonic) variation is closely related to **phonotactics**.

- [i] can't occur before nasal consonants in English.
- [ĭ] can't occur *except* before nasal consonants in English.

Compare:

- Words cannot begin with [ŋ] in English.
- Words cannot begin with [p^ht^h] in English, *[p^ht^hil].

Allophones like [i] and [ĭ] are **what we hear** - phonetic realizations of a basic sound.

Phonemes are **abstract categories**

(Hayes textbook: like the birthday song)

- / i / is a *label* for a sound that has different, physical phonetic realizations depending on its context.

Another analogy: hats

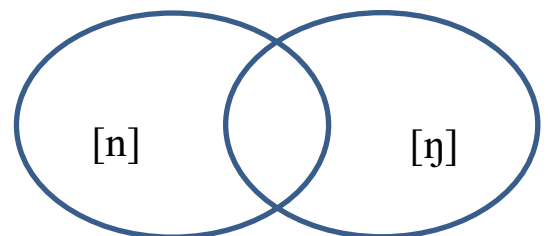
- We have a general concept of a “hat” a covering for the head usually having a shaped crown and brim
- **But:** there are different kinds of hats!
And some hats are appropriate for different contexts.



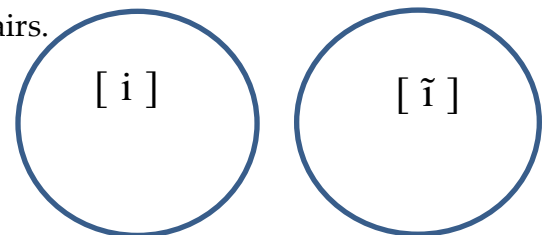
- We only wear actual, physical hats, not the concept of a “hat”.

Different kinds of distributions

- When two sounds are **contrastive**:
 - They **belong to different phonemes**.
 - They have an **unpredictable distribution** - occur in some of the same environments.
 - They are in **overlapping distribution**...
 - ...also known as *contrastive distribution*.



- When two sounds are **allophones of the same phoneme**:
 - They are **not contrastive** - can't form minimal pairs.
 - They occur in **different environments**.
 - They have a **predictable** distribution.
 - They have a **non-overlapping** distribution...
 - ...also known as *complementary distribution*.



Note: complementary, not complimentary

- ‘Complements’ = things that come as a pair or set (e.g. peanut butter and jelly, or [i] and [ĩ])
- ‘Compliments’ = nice things you say to people

Exercise #1: Georgian

The symbol [ɬ] indicates a 'dark l' or 'velarized [l]'. It's like the [l] in English *light* [laɪt], but with an additional [u]-like dorsal constriction in the velar region.

[ɬ] is an example of a **complex segment**, with a **secondary articulation**. It could also be transcribed [lʷ] to indicate secondary velarization more clearly.

In Georgian, both plain [l] (sometimes called 'light l') and [ɬ] occur. Are these sounds allophones of **different phonemes**, or allophones of the **same phoneme**?

ɬamazad	'prettily'
lefo	'goal'
saxɬji	'at home'
ɬxena	'joy'
kbiɬs	'tooth'
zarali	'loss'
kaɬa	'tin'
pepeɬa	'butterfly'
kleba	'reduce'
ert ^h xet	'once'
xeli	'hand'
xofo	'however'
ts ^h ets ^h xli	'fire'
vxlet ^h	'I split'
ts ^h oli	'wife'

What methodology should we use?

- (1) Look for **minimal pairs** - these clearly indicate contrast.
- (2) If there are no minimal pairs, **consider the environments** each sound occurs in.
 - Non-overlapping environments ⇒ complementary distribution ⇒ 1 phoneme
 - Overlapping environments ⇒ contrastive distribution ⇒ 2 phonemes
- (3) Look for **patterns across the contexts** each sound occurs in.
 - Predictable allophones usually occur in contexts that **share some phonetic property**, and/or which **make some phonetic sense**.

NEAR-MINIMAL PAIRS

It isn't always possible to find minimal pairs for contrastive sounds.

- Can you think of any minimal pairs for English [ð]~[ʒ]?

But: even when we can't find minimal pairs, we can ask whether two sounds **occur in the same environments**.

- This establishes the *potential for contrast*.

(1) *dream* [dɹim] ~ *grain* [gɹiɛm]

(2) *bed* [bɛd] ~ *leg* [lɛg]

(3) *adobe* [ə.'dɒʊ.bi] ~ *ago* [ə.'gɒʊ]

Examples like (1)-(3) are **near-minimal pairs**:

- Not *true* minimal pairs...
- ...but they show that minimal pairs are *possible*...
- ...because the sounds occur in overlapping environments.

(4) *drain* [dɹiɛm] ~ *grain* [gɹiɛm]

(5) *bed* [bɛd] ~ *beg* [bɛg]

Important note: there are lots of different ways we could define the “context” a sound occurs in!

- Experience teaches us that the **local environment** A __ B -- which consists of only adjacent sounds -- is the most important context.
- Other properties, like stress, can matter too (see (3) above).
- Near-minimal pairs are identical with respect to all phonetic properties that we think might be *relevant*.

Are the following near-minimal pairs for [ð ʒ]? Transcribe them to check.

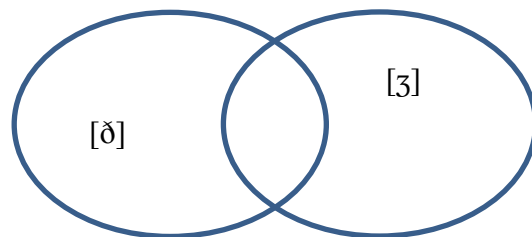
(1) *leather* ~ *measure*

(2) *neither* ~ *seizure*

(3) *smooth* ~ *rouge*

Like minimal pairs, near-minimal pairs prove that two sounds **could not plausibly be allophones of the same phoneme**.

- If [ð]~[ʒ] belonged to the same phoneme, their distributions should be predictable.
 - The local contexts where [ð] occurs should be consistent...
 - ...and *different* from the contexts in which [ʒ] occurs.
 - This is not the case.
- (Near-)minimal establish overlapping distribution, and thus **unpredictability and contrast**.



Are the following near-minimal pairs? Transcribe them to check. What contrasts do they help establish?

(1) *ran* ~ *tram*

(2) *blend* ~ *land*

(3) *racing* ~ *raisin*

MORE PHONEMIC ANALYSIS PRACTICE

Exercise #2: Tojolabal (Mayan, Southern Mexico)

Are [t] and [tʰ] allophones of the same phoneme in Tojolabal, or allophones of different phonemes? How can we tell?

[t] - [tʰ]

1. čitam 'pig'

2. makton 'a patch'

3. potot' 'kind of plant'

4. tinan 'upside down'

5. čatatʰ 'kind of plant'

6. mutʰ 'chicken'

7. nahatʰ 'long'

8. ʔinatʰ 'seed'

Small note: [č] = [tʃ] in the IPA.

The symbol [č] comes from a slightly different transcription system, called 'Americanist' transcription.

What about [k] and [k'] in Tojolabal? Are they contrastive, or are they allophones of a single phoneme?

[k] - [k']

9. *kisim* 'my beard'

10. *koktik* 'our feet'

11. *p'akan* 'hanging'

12. *sak* 'white'

13. *skuču* 'he's carrying it'

14. *snika* 'he stirred it'

15. *čak'a* 'chop it down'

16. *k'ak* 'flea'

17. *k'aʔem* 'sugar cane'

18. *k'ifin* 'warm'

19. *k'utes* 'to dress'

20. *ʔak'* 'reed'

Brief phonetics note: [k'] is an **ejective consonant** (sometimes transcribed [kʔ])

- Closing the glottis and raising the larynx **increases pressure** in the vocal tract.
- Extra pressure creates sharp 'pop' at closure release, followed by a period of glottal closure.

Production of Ejectives (Catford 1988: 23)

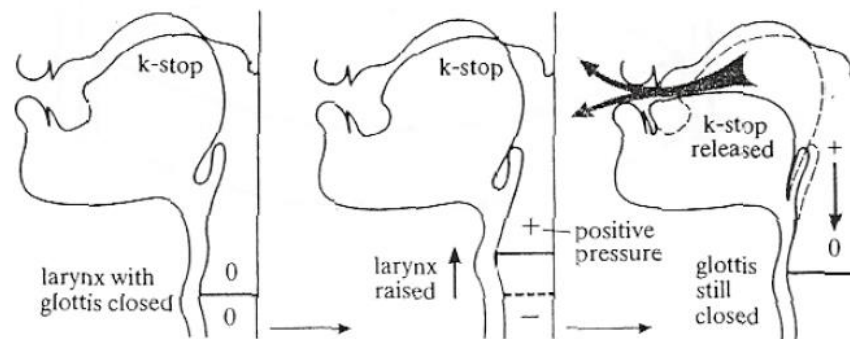


FIG. 10. Three stages in the production of glottalic pressure [k']

Reminder: two languages could have exactly the *same surface phonetic sounds*, but a *different phonemic organization* for those sounds.

Khmer (Austroasiatic, Cambodia and neighboring regions)

[pa] 'father' [p^ha] 'silk cloth'

[tu] 'chest' [t^hu] 'relaxed'

[kæ] 'repair' [k^hæ] 'month'

English: voiceless stops are *predictably aspirated* in word-initial position.

pot [p^hat] vs. *spot* [spat] vs. *rapid* [ɹæ.pɪd]

cop [k^hap] vs. *scoop* [skup] vs. *hacking* [hæ.kɪŋ]

top [t^hap] vs. *stool* [stuːl] vs. *batting* [bæ.tɪŋ] (with flapping)

American English light [l] and dark [ɫ]:

<i>please</i>	[pliz]	<i>bell</i>	[beɫ]
<i>lease</i>	[lis]	<i>coal</i>	[k ^h ouɫ]
<i>elude</i>	[əluɪd]	<i>mall</i>	[maɫ]
<i>truly</i>	[truɪli]	<i>cool</i>	[kuɫ]
<i>policy</i>	[pələsi]	<i>ball</i>	[baɫ]
<i>glue</i>	[glu]	<i>bowl</i>	[boʊɫ]
<i>allow</i>	[əlaʊ]	<i>pull</i>	[pʊɫ]
<i>bleed</i>	[blid]	<i>seal</i>	[siɫ]
<i>slyly</i>	[slaɪli]	<i>file</i>	[faɪɫ]
<i>halo</i>	[heɪlou]	<i>rail</i>	[ɹeɪɫ]

- How is the distribution of [l] and dark [ɫ] in American English *similar* to the distribution of these sounds in Georgian?
- How is the distribution of [l] and dark [ɫ] in American English *different* from the distribution of these sounds in Georgian?

[s] and [z] in Oneida

What's the phonemic relationship between [s] and [z] in Oneida (Iroquoian, historically New York, now also Wisconsin and Ontario)?

[s]		[z]	
[lashet]	‘let him count’	[kawenezuzeʔ]	‘long words’
[laʔsluni]	‘white men’	[khaiize]	‘I am taking it along’
[loteswatu]	‘he’s been playing’	[lazel]	‘let him drag it’
[skahnehtat]	‘one pine tree’	[tahazehteʔ]	‘he dropped it’
[thiskate]	‘a different one’	[tuzahatiteni]	‘they changed it’
[sninuhe]	‘you buy’	[wezake]	‘she saw you’
[wahsnestakeʔ]	‘you ate corn’		

Is the status of [s] and [z] in Oneida the same as their status in English, or different? Why?

PHONETIC SIMILARITY

Complementary distribution doesn't always correctly identify allophones of the same phoneme.

Sometimes, complementary distribution is just accidental.

- English /h/ and /ɱ/ (distributions slightly simplified)

<i>hang</i> ['hæŋ]	<i>ring</i> ['ɪŋ]	<i>sung</i> ['sʌŋ]	<i>bang</i> ['bæŋ]	<i>long</i> ['lɔŋ]~['lɑŋ]
<i>hood</i> ['hʊd]	<i>hill</i> ['hɪɫ]	<i>hum</i> ['hʌm]	<i>hat</i> ['hæt]	<i>help</i> ['hɛlp]

<i>veh<u>ic</u>ular</i> [vi'hɪkjələ]	<i>veh<u>ic</u>le</i> ['viɪkl̩]
<i>proh<u>ib</u>it</i> [pɹoʊ'hɪbɪt]	<i>proh<u>ib</u>ition</i> [pɹoʊɪ'bɪʃən]

Vietnamese *Nguyen* [ɲwɪn] > English [ɲwɪn] or [ɲjən]

Are the following words possible words of English?

sung ['sʌŋ] vs. ?['ɲʌs]
hum ['hʌm] vs. ?['mʌh]

- English /k/ and /p^h/ - non-overlapping distribution.

pot [p^hat]
scoop [skup] vs. *hacking* [hæ.kɪŋ]

We need another criterion: **phonetic similarity**.

Supporting evidence: **alternations**.

- We find lots of alternations between phonetically-related allophones.

[k]~[k^h]: *provoke* [pɹə'vʊʊk] vs. *provocation* [pɹʌvə'k^hɛɪ.ʃən]
 [p]~[p^h]: *type* [taɪp] vs. *typology* [taɪpələdʒi]

- But no such alternations exist for:
 - [h] and [ɱ] (e.g. hypothetical *sóŋg* ~ *sohólogy*)
 - [p] and [k^h]
 - [k] and [p^h]

Larger point: allophony isn't random! It often shows **phonetically sensible patterning**.

- *Allophones tend to be phonetically similar:*
 - English /k/ aspiration: /k/ → [k^h]
- *Sets of phonetically similar sounds showing the same alternations:*
 - English aspiration: /p t k/ → [p^h t^h k^h] / # ____
- *Phonetic similarity across contexts an allophone occurs in:*
 - Georgian /l/ lightening: /l/ → [l] / ____ [e i]
- *Phonetic similarity between allophones and their contexts:*
 - Oneida /s/-voicing: /s/ → [z] / [V] ____ [V]
 - Georgian /l/ lightening: /l/ → [l] / ____ [e i]

You have to know about phonetics to see these patterns!

PHONEMES AND ALLOPHONES IN LANGUAGE ACQUISITION

Children learn phonemic/allophonic categories through **distributional learning**.

- **Young infants** (4-6 months) can perceptually **distinguish all phonetic differences used contrastively** in the world's languages.
 - Evidence: headturn preference procedure, preferential sucking, etc.
- Sometime between 6-12 months, infants lose this ability.
 - At this point, infants can only perceptually distinguish between **different phonemes in their native language(s)**.
 - All of this occurs **before infants understand any words!**

