

The background features abstract, organic shapes in shades of orange and grey, resembling topographical contour lines or fluid patterns, set against a white background.

LIGN 111

# Allophones & Phonemes

6 January 2022

# Predictability

We can predict aspects of the pronunciation of words:

English:

[k<sup>h</sup>æt]

[t<sup>h</sup>æt]

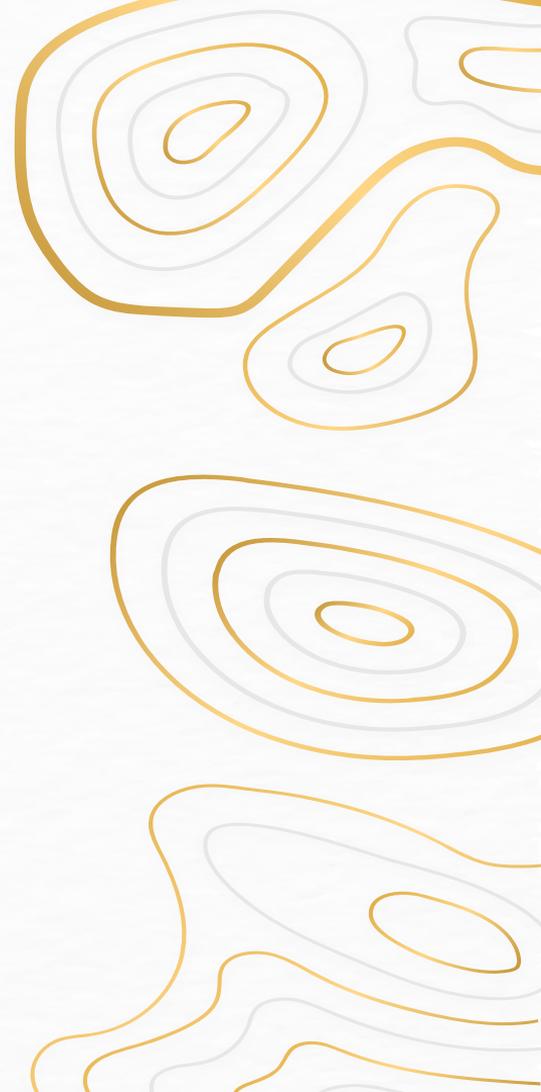
\*[kæt]    \*[tæt]

[skæt]

[stæt]

\*[sk<sup>h</sup>æt]    \*[st<sup>h</sup>æt]

\* = not possible, ungrammatical



# Predictability

We can predict aspects of the pronunciation of words:

English:

[k <sup>h</sup> æt]	[t <sup>h</sup> æt]	*[kæt]	*[tæt]
[skæt]	[stæt]	*[sk <sup>h</sup> æt]	*[st <sup>h</sup> æt]

[k<sup>h</sup>] [t<sup>h</sup>] occur at the beginning of words; [k] [t] occur after [s]

\* = not possible, ungrammatical



# Predictability

We can generalize this:

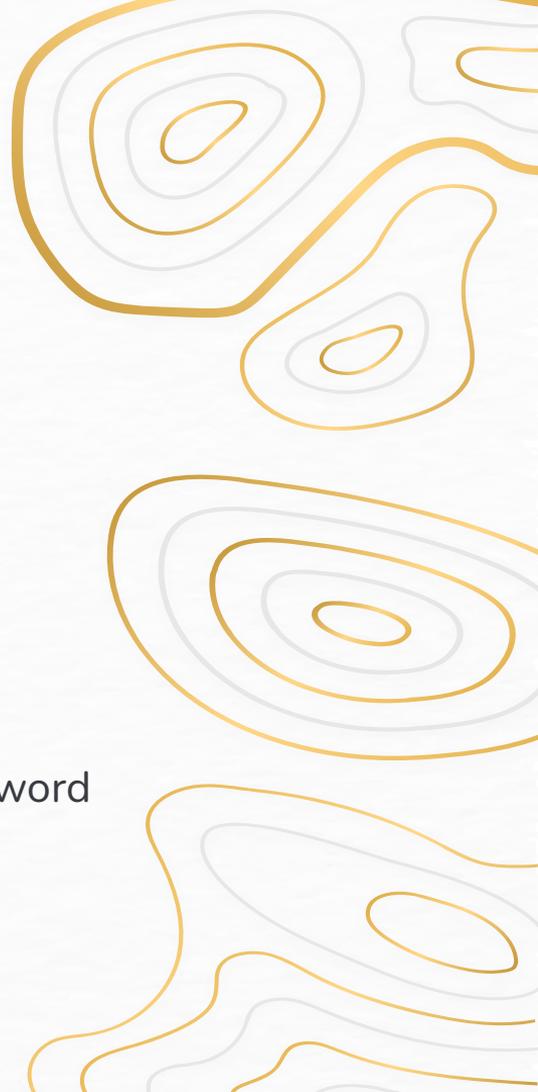
Bilabial stops: [p<sup>h</sup>æt] [spæt]      \*[pæt] \*[sp<sup>h</sup>æt]

Other words: [p<sup>h</sup>ɪl]      [t<sup>h</sup>ɪl] [k<sup>h</sup>ɪl]  
[spɪl] [stɪl] [skɪl]

In English,

**Voiceless stops** (or plosives) are *aspirated* at the beginning of the word

**Voiceless stops** are *unaspirated* after [s]



# Predictability

But we can't predict *which* of the voiceless aspirated stops will occur in word initial environment or which of the voiceless unaspirated stops will occur after [s]:

## Word-initial

[k<sup>h</sup>æt]

'cat'

[t<sup>h</sup>æt]

'tat'

[p<sup>h</sup>æt]

'pat'

## post-s

[skæt]

'scat'

[stæt]

'stat'

[spæt]

'spat'



# Predictability

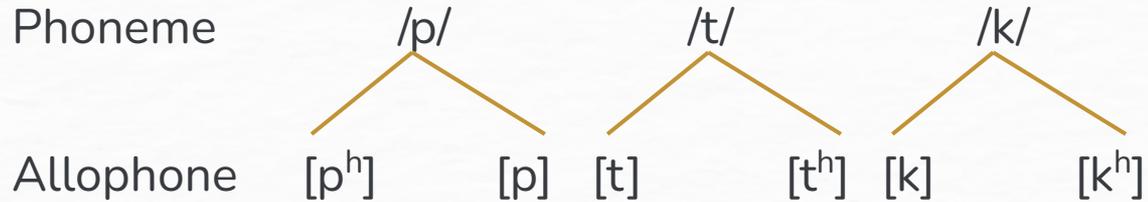
What is the relationship between

- [p] and [p<sup>h</sup>]
- [t] and [t<sup>h</sup>]
- [k] and [k<sup>h</sup>]

They are variants of the same basic sound → *allophones* of the same phoneme

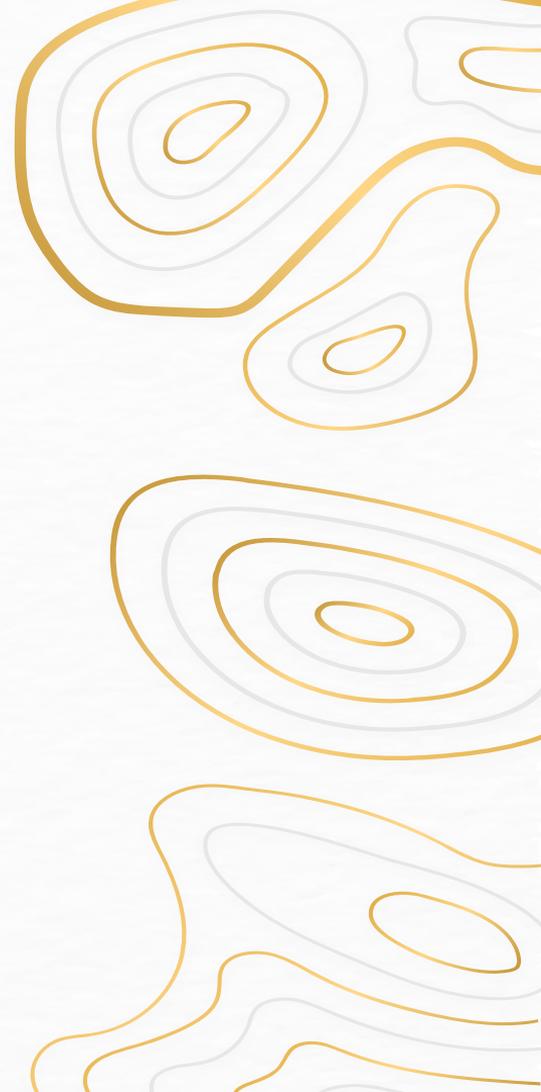


# Predictability



Phoneme is the mental representation of the sound

Allophone is the concrete realization of the sound



# More data

Labial	Coronal	Dorsal
p <sup>h</sup> leɪ		k <sup>h</sup> leɪ
p <sup>h</sup> ʲeɪ	t <sup>h</sup> ʲuθ	k <sup>h</sup> ʲæb
spleɪ		sklərou̯sɪs
spɹeɪ	stɹeɪ	skɹɪm

The generalization holds, even if the following sound is not a vowel



# More data

## Labial

p<sup>h</sup>api

hæpi

hɛlpɪŋ

səp<sup>h</sup>oʊz

ɹɪspɛt

## Coronal

t<sup>h</sup>afi

sɪtɪ\*

salti

ətɫæntɪk

ət<sup>h</sup>æk

ɹɛstɔɹ

## Dorsal

k<sup>h</sup>aki

ɪɫki

mɪɫkɪŋ

əknaɪdʒ

ək<sup>h</sup>ɔɹd

ɛskɔɹt

\* UK Received Pronunciation English; in North America, this would be [sɪɹɪ]



# More data

## Labial

'p<sup>h</sup>ɑpi

'hæpi

'hɛlpɪŋ

sə'p<sup>h</sup>oʊz

ɹɔts'ɛr

## Coronal

't<sup>h</sup>ɑfi

'sɪtɪ\*

'saltɪj

ət'læntɪk

ət<sup>h</sup>æk

ɹɔts'ɛr

## Dorsal

'k<sup>h</sup>ɑki

'lʌki

'mɪlkɪŋ

ək'nɑɪɪdʒ

ək<sup>h</sup>ɔɪd

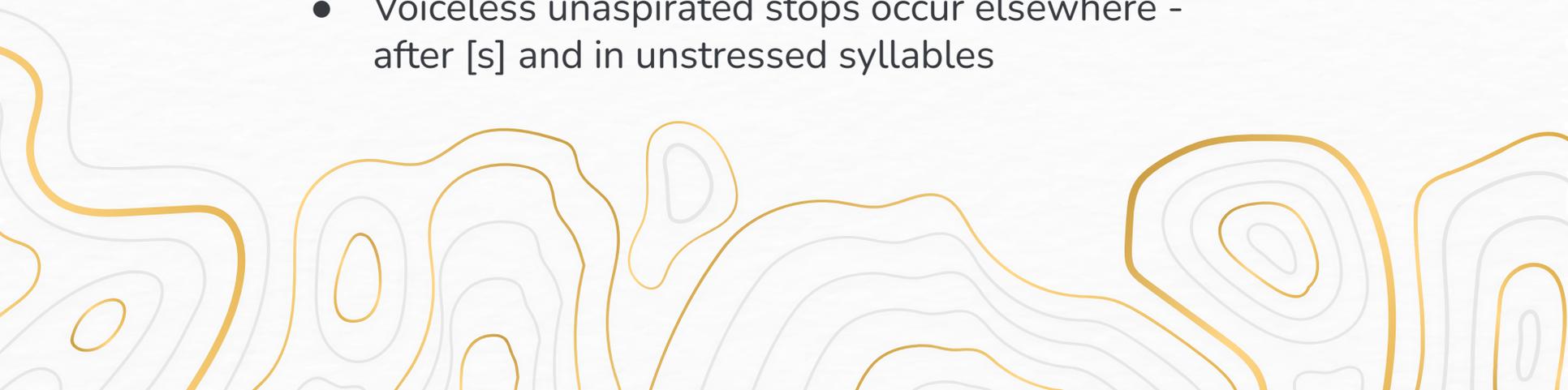
ɛ'skɔt

\* UK Received Pronunciation English; in North America, this would be ['sɪrɪ]

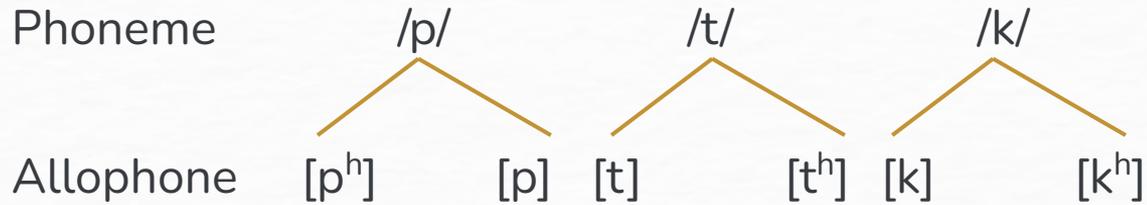


# Revision to generalization

- Voiceless aspirated stops occur at the beginning of stressed syllables  
(Single syllable words such as [ ' pæk] are stressed)
- Voiceless unaspirated stops occur elsewhere - after [s] and in unstressed syllables



# Predictability



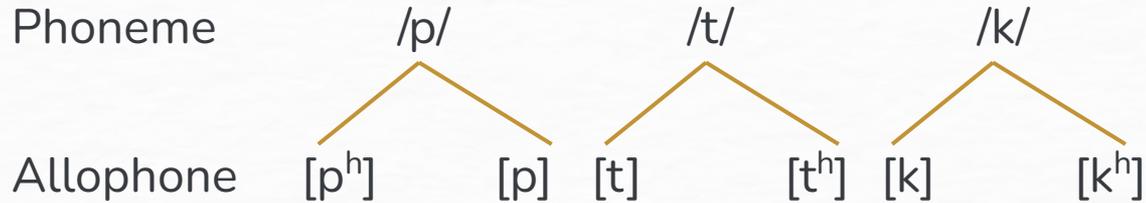
We select one of the sounds to ‘represent’ the phoneme, and derive the other one by rule:

$/p/ \rightarrow [p^h]$  / at beginning of stressed syllable

But there is still an assumed ‘elsewhere’ rule:

$/p/ \rightarrow [p]$  elsewhere

# Predictability



Generalize: /p t k/ → [p<sup>h</sup> t<sup>h</sup> k<sup>h</sup>] / beginning of stressed syllable

**Or**

Voiceless stops become aspirated at the beginning of a stressed syllable



# Predictions for other data

How would English speakers pronounce new words?  
Or non-English names?

Soccer players: Achraf **Hakimi**  
Romelu **Lukaku**  
Wahbi **Khazri**

Depends where the stress goes, but here's how English  
football commentators pronounce them:

[ha 'k<sup>h</sup>imi] [lu 'k<sup>h</sup>aku] ['k<sup>h</sup>azri]



# Predictions for other data

When English (adult) speakers learn a new language, they will automatically aspirate and unaspirate in the wrong places

Hindi	[p <sup>h</sup> al]	‘fruit’	[pal]	‘want’
	[st <sup>h</sup> al]	‘place’	[stan]	‘breast’



# Predictions for other data

If a word is broken into syllables and each syllable pronounced separately, aspiration will occur if a stop is syllable initial:

**hæ ..... p<sup>h</sup>i**

→ because each syllable is pronounced with stress

(Thanks to Odden (2005) for this insight)

# Solving problems

- Given a set of data from a language, how do you know what the distribution of the sounds is?
- How do you determine the categorization of sounds into phonemes and allophones?



# Contrastive distribution

Within words, we can determine whether sounds are contrastive or not by examining their distribution with respect to other sounds, syllables and word edges

*Contrastive distribution*: occur in same environment, but difference in meaning:

i.e. [fæn] 'fan' [væn] 'van'

**Environment:** Both [f] and [v] occur at the beginning of the word before the sequence [æn]

**Meaning:** The two words mean different things

→ [f] and [v] belong to separate phonemes



# Minimal pair

The best evidence for contrastive distribution is a **minimal pair**: a pair of words with distinct meanings but which differ by only one sound or sign articulation (ex. handshape)

ex. English [fæ̃n] and [væ̃n] ‘fan’ and ‘van’  
[dʌf] and [dʌv] ‘duff’<sup>1</sup> and ‘dove’

[pɛ̃n] and [pɪ̃n] ‘pen’ and ‘pin’  
(.....for those speakers that have this *contrast!*)

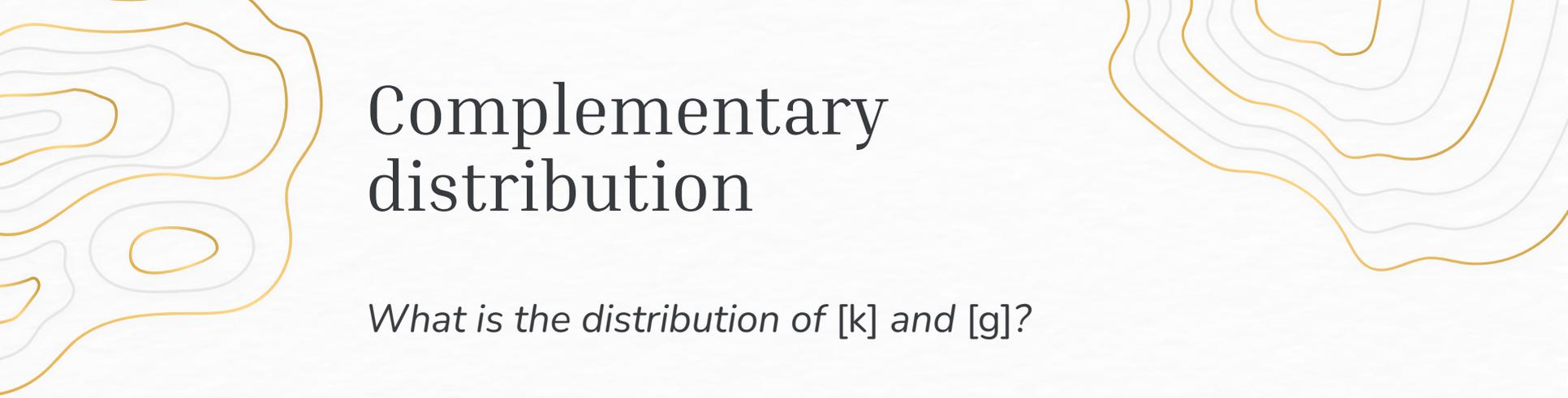
<sup>1</sup> boiled or steamed pudding often containing dried fruit; the partly decayed organic matter on the forest floor; fine coal; buttocks



# Complementary distribution

*Complementary distribution*: sounds occur in distinct, complementary environments and therefore their distribution is predictable

→ allophones of the same phoneme



# Complementary distribution

*What is the distribution of [k] and [g]?*

**Rere** (Kordofanian, Sudan)

kal 'stone'

kɔlaw 'cat'

kɛril:i 'nail'

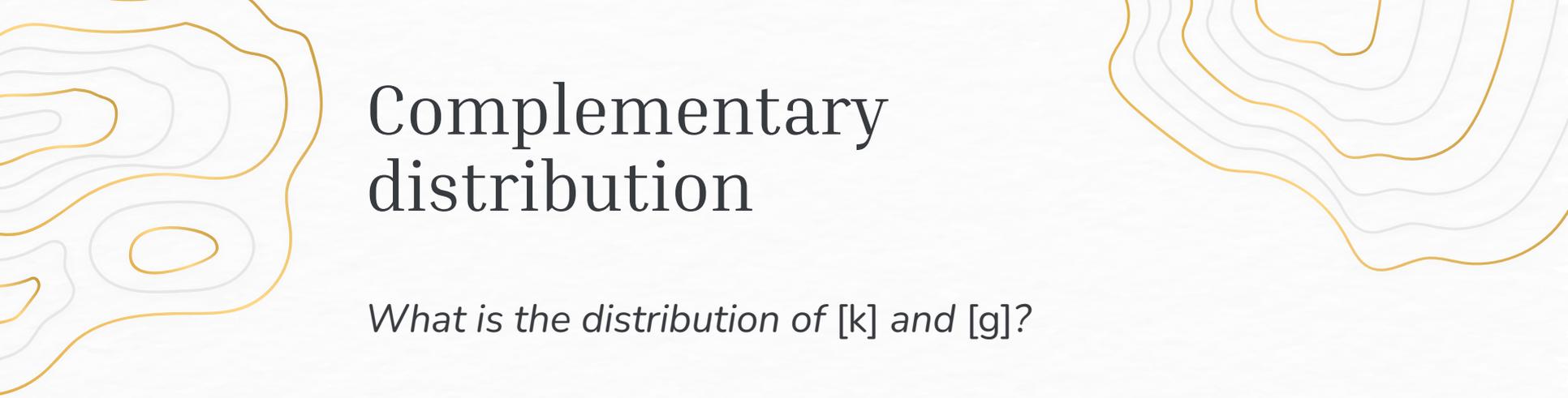
ɬugi 'plant thorn'

ŋɛɾiŋgɛ 'donkeys'

kɛrəgɛ 'hand'

kɔgra 'throat'

ŋgo 'this'



# Complementary distribution

*What is the distribution of [k] and [g]?*

**Rere** (Kordofanian, Sudan)

**k**al 'stone'

**k**ɔlaw 'cat'

**k**eril:i 'nail'

ɬ**u**gi 'plant thorn'

ɲɛɾɪŋ**g**e 'donkeys'

**k**erə**g**e 'hand'

**k**ɔ**g**ra 'throat'

ŋ**g**o 'this'

# Complementary distribution

[k] / # \_\_ a

# \_\_ u

# \_\_ ε

# \_\_ ɔ

**k**al 'stone'

**k**ulaw 'cat'

**k**εril:i 'nail'

ɬ**u**gi 'plant thorn'

ɲεɾɪ**ŋ**gε 'donkeys'

**k**εrεgε 'hand'

**k**ɔgra 'throat'

ɲ**g**o 'this'

# Complementary distribution

[k] / # \_\_ a

# \_\_ u

# \_\_ ε

# \_\_ ɔ

# = word boundary

/ = 'in environment of'

# **k** a l

**k**al 'stone'

**k**ulaw 'cat'

**k**εril:i 'nail'

ɬugi 'plant thorn'

ɲεɾiŋ**g**ε 'donkeys'

**k**εr**εg**ε 'hand'

**k**ɔ**g**ra 'throat'

ŋ**g**o 'this'

# Complementary distribution

[k] / # \_\_ a

# \_\_ u

# \_\_ ε

# \_\_ ɔ

# = word boundary

/ = 'in environment of'

#     a |

**k**al 'stone'

**k**ulaw 'cat'

**k**εril:i 'nail'

ɬu**g**i 'plant thorn'

ɲεɾi**ŋg**e 'donkeys'

**k**εr**εg**e 'hand'

**k**ɔ**g**ra 'throat'

ɲ**g**o 'this'



# Complementary distribution

Generalize: [k] / # \_\_ V

(V = vowel)

**k**al 'stone'

**k**ɯlaw 'cat'

**k**ɛril:i 'nail'

ɬ**u**gi 'plant thorn'

ɲɛɾɪŋ**g**ɛ 'donkeys'

**k**ɛrə**g**ɛ 'hand'

**k**ɔ**g**ra 'throat'

ŋ**g**o 'this'

# Complementary distribution

[g] / u \_\_\_ i  
          η \_\_\_ e  
          ə \_\_\_ ε  
          ɔ \_\_\_ r  
          η \_\_\_ o

**k**al           ‘stone’

**k**ulaw       ‘cat’

**k**eril:i      ‘nail’

ɬu**g**i         ‘plant thorn’

ɲɛɾi**ŋg**e    ‘donkeys’

**k**erə**g**e      ‘hand’

**k**ɔ**g**ra       ‘throat’

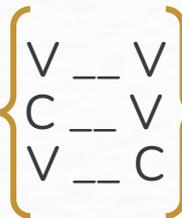
η**g**o         ‘this’

# Complementary distribution

[g] / between vowels

after a consonant and before a vowel

after a vowel and before a consonant



C = consonant

{ } = disjunctive  
(one or the other)

**k**al 'stone'

**k**ulaw 'cat'

**k**eril:i 'nail'

tu**g**i 'plant thorn'

neɾiŋ**g**ə 'donkeys'

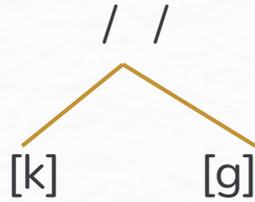
**k**erə**g**ɛ 'hand'

**k**ɔ**g**ra 'throat'

ŋ**g**o 'this'



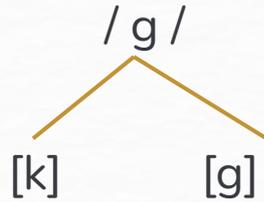
# Complementary distribution



Write the simplest rule, one that requires a single, specific environment.

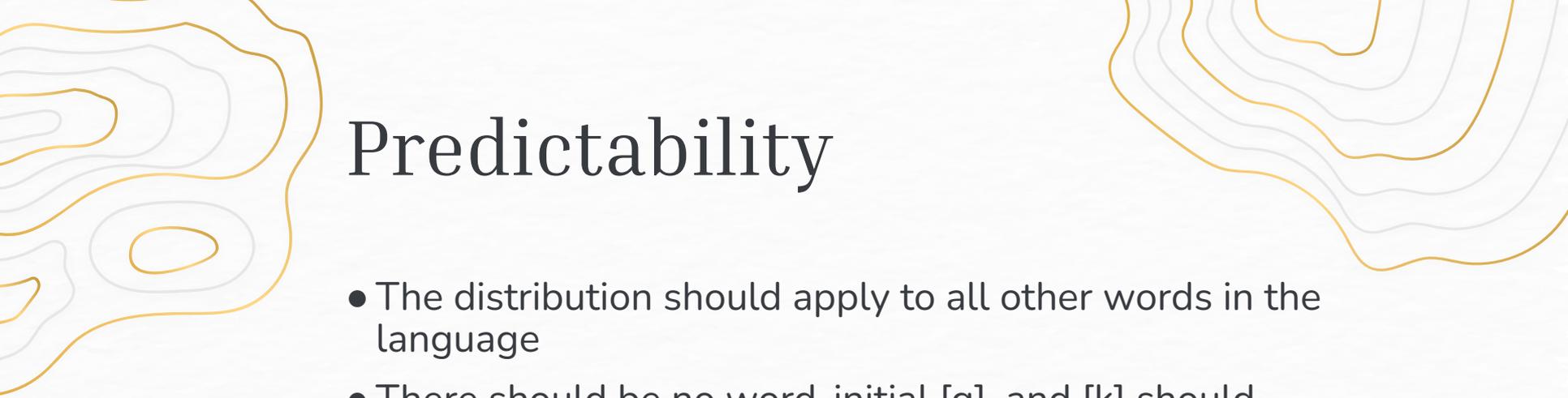
Therefore, select the allophone that occurs in the widest contexts to represent the phoneme and derive the other allophone by rule

# Complementary distribution



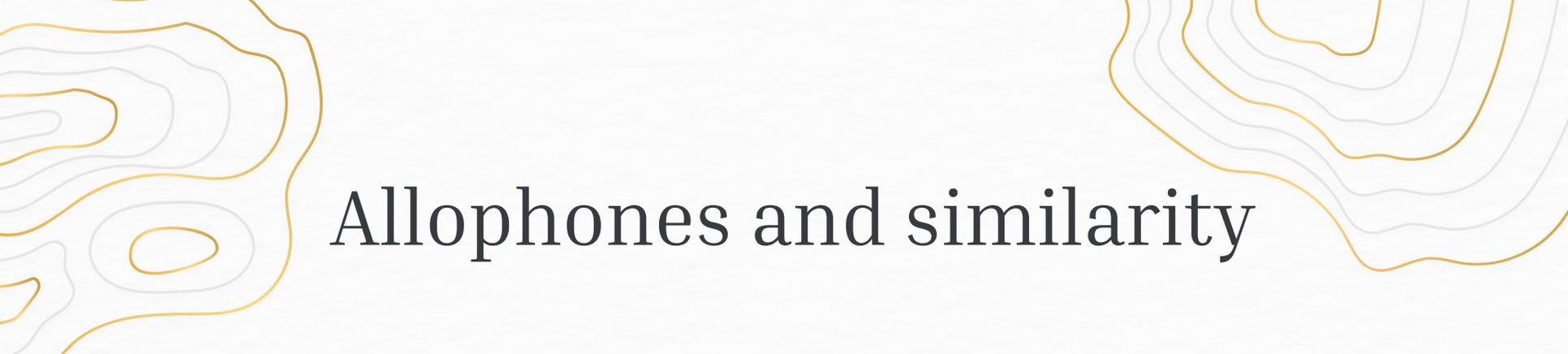
Write the simplest rule, one that requires a single specific environment.

Rule of devoicing:  $/g/ \rightarrow [k] / \# \text{ \_\_\_}$



# Predictability

- The distribution should apply to all other words in the language
- There should be no word-initial [g], and [k] should only occur word-initially
- It predicts that Rere speakers may have trouble pronouncing a word-initial [g] and that this effect may carry over to a second language
  - Why? allophone pronunciation tends to be automatic and not something speakers pay attention to or consciously notice they are doing



# Allophones and similarity

- Allophones of the same phoneme are similar to each other in articulatory/acoustic properties: so
  - ✓ [k] and [k<sup>h</sup>] both voiceless velar stops – differ in *aspiration*
  - ✓ [g] and [k] both velar stops – differ in *voicing*
  - ✓ [g] and [ŋ] both voiced velar stops – differ in *nasality*
  - ?? [p] and [r] nothing in common except being consonants
    - unlikely to be allophones of a single phoneme

# Steps in determining distribution



## 1. Look for minimal pairs

If there are minimal pairs

→ conclude that they are allophones of different phonemes

If there are no minimal pairs, proceed to step 2

# Steps in determining distribution

## 2. How do the sounds differ from each other?

- voicing difference
- place difference
- height difference etc..

This will help you figure out the environment that might be causing the distribution if they turn out to belong to the same phoneme.



# Steps in determining distribution



## 3. List environments.

Examine the words to see where the sounds occur

**[a]**

p \_\_ m

n \_\_ k

f \_\_ g

k \_\_ b

l \_\_ f

**[e]**

b \_\_ tʃ

l \_\_ s

r \_\_ d

k \_\_ t

n \_\_ dʒ

# Steps in determining distribution



## 4. Generalize the environment

- Do the two sounds occur in complementary environments?
- Think about how they differ and what might be causing the change.
- Check the left hand and the right hand side of the \_\_\_

**[a]**

p \_\_ m

n \_\_ k

f \_\_ g

k \_\_ b

l \_\_ f

**[e]**

b \_\_ tʃ

l \_\_ s

r \_\_ d

k \_\_ t

n \_\_ dʒ

# Steps in determining distribution



## 4. Generalize the environment

[a]

p	—	m
n	—	k
f	—	g
k	—	b
l	—	f

[e]

b	—	tʃ
l	—	s
r	—	d
k	—	t
n	—	dʒ

# Steps in determining distribution



## 4. Generalize the environment

[a]

p	—	m
n	—	k
f	—	g
k	—	b
l	—	f

labial  
and  
velar

[e]

b	—	tʃ
l	—	s
r	—	d
k	—	t
n	—	dʒ

alveolar and  
alveopalatal

# Steps for alternation problems



5. **Determine the allophone that represents the phoneme**
  - occurs in most general environment
  - the phonological rule used to generate the other alternants is simple, more natural and more common cross-linguistically
  - the phonological rule accounts for all the data

# Steps for alternation problems



## 6. Write a phonological rule

a rule may apply to a single segment or groups of segments that constitute a **natural class**, such as voiceless consonants, labials, front vowels, etc..

rules are generally of the shape

$A \rightarrow B / C \_\_\_$

$A \rightarrow B / \_\_\_ D$

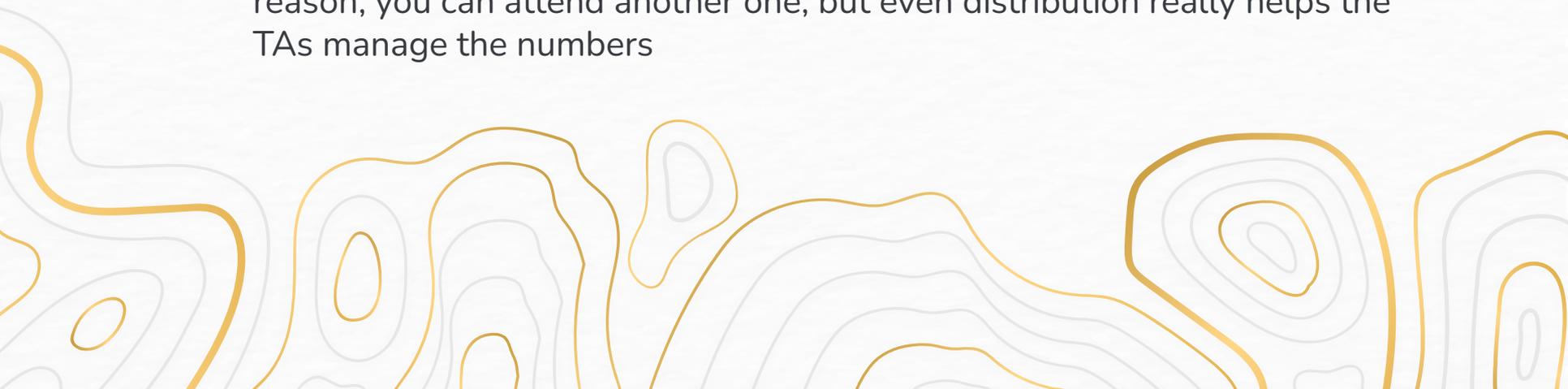
$A \rightarrow B / C \_\_\_ D$

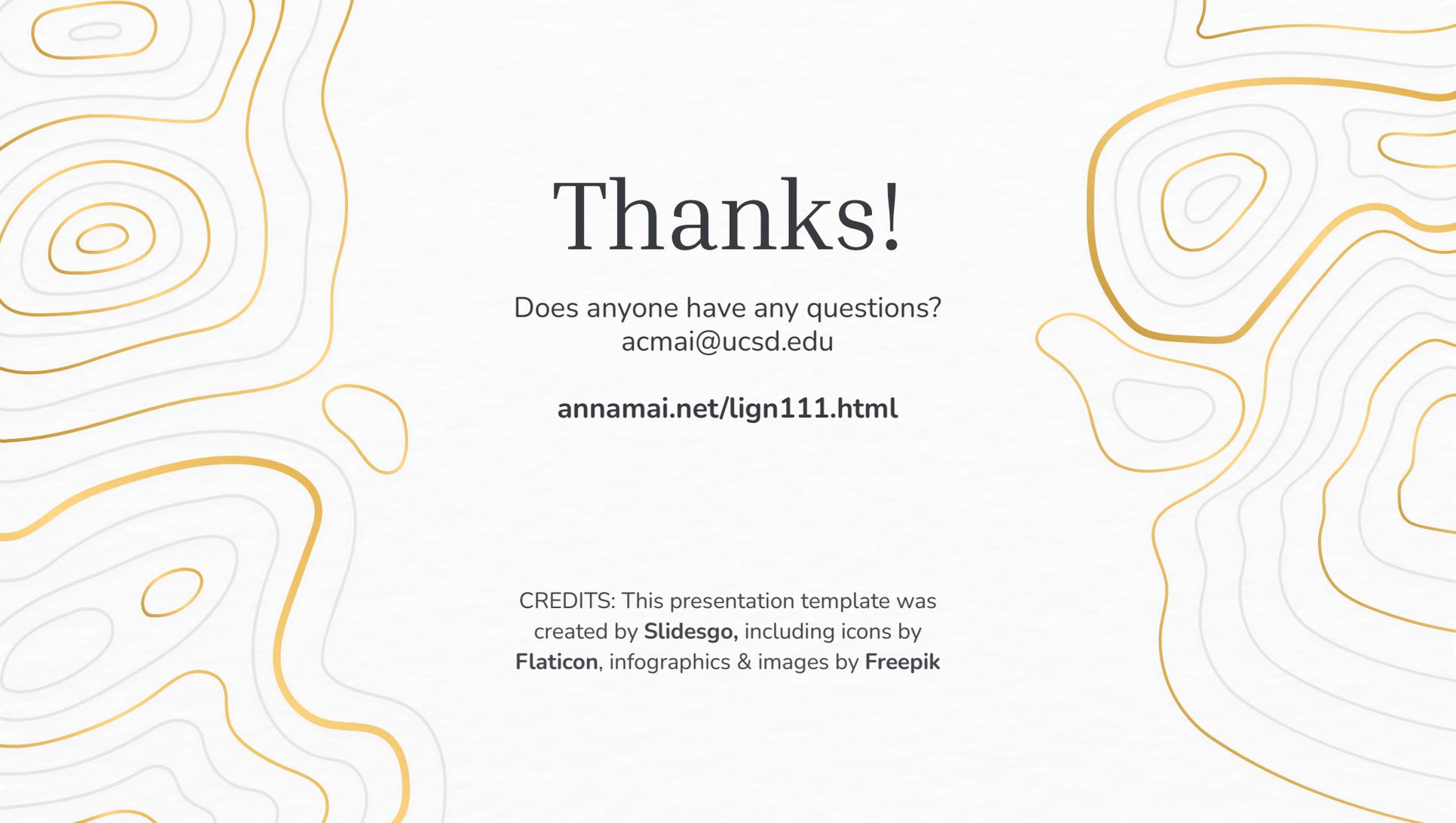
# Steps

1. **Look for minimal pairs.** If there are none, proceed to 2
2. **How do the sounds differ from each other?**
3. **List environments**
4. **Generalize the environments**
5. **Determine the allophone that represents the phoneme**
6. **Write a phonological rule**

# For Tuesday

- Please fill out the language background survey
- Quiz 1 will be due before class (10am). It will be released later today.
- HW 1 will also be released later today (due next Thurs 23h59)
- Remember that Sections start in Week 2!
- Please attend the section that you registered for – if you can't for some reason, you can attend another one, but even distribution really helps the TAs manage the numbers





# Thanks!

Does anyone have any questions?  
acmai@ucsd.edu

[annamai.net/lign111.html](http://annamai.net/lign111.html)

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