Today's objectives:

- **Motivating syllables, continued**

Background preparation:

- *continuing from discussion last time*

0. Today's plan

- English aspiration: Facts about the world
  - *Last time:* What are your **intuitions** about which voiceless stops are aspirated?
  - *This time:* What happens when we **check**, phonetically and perceptually?
- English aspiration: Phonological analysis
  - How can we make our **model** describe/predict/explain where aspirated stop allophones occur?
- Check-in on WU #1

1. Which English voiceless stops are aspirated?

- Reminder: Aspiration
  - Some voiceless stops are **aspirated** — produced with a puff of air [^{h}] after the stop release
  - **Unaspirated** stops do not have this puff of air

- In **English**, voiceless stop phonemes /p t k/ have aspirated **allophones** [p^{h} t^{h} k^{h}]
  - How can we use our **model** of the phonological grammar to **describe/predict/explain** the environment where aspiration occurs?

1. Which English voiceless stops are aspirated?

Discussion

- Data set: English aspiration
  - Which of the stops in part (1) are **aspirated**?

(a)	(b)	(c)	(d)
pan	s**p**an	**p**ray	s**p**ray
(e)	(f)	(g)	(h)
a**pp**ear	a**pp**rove	com**p**are	as**p**ire

- Intuitions are not always clear
  - Allophones can be hard to distinguish!

1. Which English voiceless stops are aspirated?

- We can see aspiration on an **acoustic analysis** display (waveform + spectrogram)
  - Can we see a clear difference between aspirated and unaspirated stops in our data set?
  - How much aspiration is enough to “count”?

2. A fun way to check for aspiration

- English **voiced** stops have an optional allophone in word-initial position that is voiceless unaspirated

- So: If we *start* playing audio during *any* stop
  - This tricks our phonological grammar into thinking we are listening to a *word-intial* stop
  - If it's not aspirated enough to "count" as aspirated, it will **sound** "voiced" (even if there is literally no vocal-fold vibration)

2. A fun way to check for aspiration

- Which of the stops are actually aspirated?

(a)	(b)	(c)	(d)
/**p**/an	s/**p**/an	/**p**/ray	s/**p**/ray
/**t**/ar	s/**t**/ar	/**t**/ray	s/**t**/ray
/**k**/in	s/**k**/in	/**k**/ream	s/**k**/ream

(e)	(f)	(g)	(h)
a/**p**/ear	a/**p**/rove	com/**p**/are	as/**p**/ire
a/**t**/ach	a/**t**/ract	con/**t**/ent	as/**t**/ound
a/**k**/ord	a/**k**/ross	con/**k**/lude	as/**k**/ribe

2. A fun way to check for aspiration

- Which of the stops are actually aspirated?

(a)	(b)	(c)	(d)
[pʰ]an	s[p]an	[pʰ]ray	s[p]ray
[tʰ]ar	s[t]ar	[tʰ]ray	s[t]ray
[kʰ]in	s[k]in	[kʰ]ream	s[k]ream

(e)	(f)	(g)	(h)
a[pʰ]ear	a[pʰ]rove	com[pʰ]are	as[p]ire
a[tʰ]ach	a[tʰ]ract	con[tʰ]ent	as[t]ound
a[kʰ]ord	a[kʰ]ross	con[kʰ]lude	as[k]ribe

3. The environment for English aspiration

Testing our model

- Using the tools of our **phonological model** as developed so far…

  What generalization can we make about the **environment** for the aspirated allophones of the voiceless stops, based on the data above?

3. The environment for English aspiration

Testing our model

- Now consider the words in part (2) of the data set

  (i) a**pp**laud
  A**t**lantic
  a**cc**laim

  - Are these aspirated?

- Does our generalization still work for these examples?
  - Can we state a better generalization? Why or why not?

4. Motivating syllable structure

- The concept of the “syllable” has a long tradition
  - But is it linguistically motivated?

- **Should** syllable structure be **part of our model** of the mental grammar?
  - What kind of evidence would decide this question?

4. Motivating syllable structure

- What we've seen from English aspiration:
  - The environment for aspiration **can't be easily stated** in terms of neighboring segments and word boundaries only (consider *A**t**lantic*)
  - **Converging evidence** for syllable boundaries:
    - Is there aspiration in [mp]?
    - Can [mp] start a word?
    - Why are these two questions related?
- Referring to syllable structure, and syllable position, lets us give a **simpler and more explanatory analysis** of aspiration in English voiceless stops

4. Motivating syllable structure

- With reference to syllable structure…
  - **Describe** — We can describe the environment of aspiration with a single generalization
  - **Predict** — Our generalization lets us predict other environments/words where we expect to see aspiration
  - **Explain** — Our new way of describing the relevant environments shows **why** apparently distinct environments (in segmental terms) are **connected**

5. General strategies: syllable structure

- To **explain** the distribution of aspiration in English in terms of **position in the syllable**, we had to make some **decisions** about the syllable structure

Example: **c**om**p**are vs. as**p**ire

[**kʰ** ə m **pʰ** ɛ ɹ] [ə s **p** aj ɹ]

- Which decisions about English syllable structure were fairly **safe assumptions**?
- Which aspects did we have to make **proposals** about?

5. General strategies: syllable structure

- Example: **c**om**p**are vs. as**p**ire

  [**kʰ** ə m **pʰ** ɛ ɹ] [ə s **p** aj ɹ]

  - Which decisions were fairly **safe assumptions**?
    - Word edge corresponds to syllable edge
    - Number of vowels (actually, [+syll] segments!) corresponds to number of syllables
  - Which aspects did we have to make **proposals** about?
    - Where the **syllable divisions** are inside the word (which consonants belong to which syllables)

5. General strategies: syllable structure

- Our English aspiration analysis illustrates general **strategies** for syllable-structure-based analysis:
  1. *Make an initial hypothesis:* Use "straightforward" examples to get insight into how syllable structure determines a phonological pattern
  2. *Consider syllable-structure implications:* What proposal does our initial hypothesis lead us to make about syllable divisions inside words?
  3. *Look for converging evidence:* Can we show that multiple phonological patterns lead us to propose the same syllable structure?

5. General strategies: syllable structure

- What source of **converging evidence** did we find for our proposals about syllable structure in English?

5. General strategies: syllable structure

- What source of **converging evidence** did we find for our proposals about syllable structure in English?
  - **Aspiration** facts and facts about **word-initial consonant sequences** led to the **same conclusions** about which consonant clusters can start a syllable

6. Syllables and our phonological model

- Syllable structure is **phonological**, not phonetic
  - What does this mean?

6. Syllables and our phonological model

- Syllable structure is primarily about how the **mental grammar** organizes the segments in a language
  - We can't look at a data set (audio file) and "see" how the segments are combined into syllables
  - Instead, we have to **find evidence** and **make arguments** for how syllables are constructed **in each language**

    → **Which hypotheses** about how segments are syllabified provide the **best explanations** for phonological patterns?

6. Syllables and our phonological model

- Next time:

  We will begin to add to our **model** of the phonological grammar so that it can…

  - Refer to **syllables**
  - Refer to aspects of the **structure** inside syllables

  - Allow for **different** syllable-structure options in different languages
  - Capture the fact that some aspects of syllable structure are **common** across languages

7. Syllables and our phonological model

- WU #1 — Check-in
  - Any questions?

- Clarification: The model you are implementing for WU #1 is the model we had developed *before* we started looking into syllable structure