Today's topics:

- **Model building, hypothesis testing**
- **Representing speech sounds in the mental grammar**

Background preparation:

(none)

0. Today's objectives

After today's class, you should be able to:

- Explain, in general terms, what it means to
  - build a **model**
  - test **hypotheses**
- Test models of segmental representation against phonology data sets to see how well they can **describe** and **predict** segment **classes**

0. Introductions, part 2

- Check-in with names
  - Include pronouns if you would like

- Tell us all something about yourself
  - Some ideas:
    hobby,
    major(s)/minor(s),
    language interests,
    linguistics idea that struck you...

1. Building a model, testing hypotheses

Warm-up question

- In scientific investigation, what is a **model**?
  - Can you think of any **examples** of models from various areas of science?

1. Building a model, testing hypotheses

- A model is an **abstract explanatory device** designed to **account for data**
  - 'Abstract' = exists in the minds of the explainers
  - **Data** = facts that we observe about the world

  So, a model is a (complex) ***idea*** *for* ***how to think about*** *some* ***phenomenon*** *in the world*

- Having a model allows us to…

1. Building a model, testing hypotheses

- A model is an **abstract explanatory device** designed to **account for data**
- Having a model allows us to…
  - **Describe** what we observe
  - **Predict** what else should happen
  - (Attempt to) **explain** why phenomena occur
- If our model is a **good match** with how the world works, we can make a case that properties of the world are **like** properties of our model
  - We check this by **testing hypotheses** on **data**

1. Building a model, testing hypotheses

- When we propose a model, what are some of the characteristics we have to give it?
  - We propose **entities** that exist in the model
  - We propose ways in which those entities **operate** or **interact**
  - We **carefully define** those elements or entities and their operations, so that it is clear what the model allows, or requires, them to do

1. Building a model, testing hypotheses

- How do we go about **testing** a model?
  - We **use the "toolkit"** that it provides (entities, operations) and **try to account for** (describe, predict, maybe explain) **some data**
  - We have to **apply the model rigidly**, *even if we see it's not going to work,* so that we **understand** where it does and doesn't do a good job

1. Building a model, testing hypotheses

- Our first goal: Build a model of how **segments** (individual consonant and vowel sounds) are **represented** in the mental grammar
  - Based on the tongue-twister exercise, we start by proposing that segments are represented in the mental grammar in terms of _____

1. Building a model, testing hypotheses

- Our first goal: Build a model of how **segments** (individual consonant and vowel sounds) are **represented** in the mental grammar
  - Based on the tongue-twister exercise, we start by proposing that segments are represented in the mental grammar in terms of their **properties**
    - This accounts for our observation that the grammar can "tell" if segments are "similar"

  → But what is the **inventory of properties** that is used for this?

2. What properties matter?

- How do US coins differ from one another? (<Wikipedia)

2. What properties matter?

- How do US coins differ from one another? (<Wikipedia)

Some ways:				
Color	copper	silver	silver	silver
Size	smallish	medium	small	large
Edge	smooth	smooth	ridged	ridged
Weight	2.5 g	5.000 g	2.268 g	5.67 g
Image	Lincoln	Jefferson	FDR	Washington

- How could we **find out** which differences are **used by humans**? → **Hypotheses**? How to **test**?

2. What properties matter?

- We can ask this same question for **segments** (speech sounds)!
  - We can observe ways by which segments differ physically (phonetically) from one another
  - But…
    - Which of those potential differences are **used by the mental grammar**?
    - How can we **find out**?

2. What properties matter?

- How can we find out which properties of segments are used by the mental grammar?
- We can use evidence from…
  - **Phonologically active classes**: What properties are needed to account for groups of segments that *pattern together* in languages?
  - **Categories**: What properties are needed to distinguish all segments that are treated as *distinct mental sound categories* in any given language?

3. Data from consonant classes

Data set: Arabic consonants

- What sound properties are used by the grammar?
  - *Hypothesis:* The basic phonetic properties that we reviewed for the quiz are **necessary** and **sufficient** to uniquely describe each class
- Data: "Groups" are **phonologically active classes**
  - That is, each "group" is distinguished from all the other consonants by speakers' mental grammar
- What do we find if we **test** this hypothesis?

3. Data from consonant classes

Data set: Arabic consonants

Group discussion

- For each class in the data set: **Test the hypothesis!**
  - *Hypothesis:* The basic phonetic properties that we reviewed for the quiz are **necessary** and **sufficient** to uniquely describe each class
  - Can the quiz properties be used to…
    - give the class a **consistent description** (one or more properties, no “or”)?
    - **distinguish** the class from all other consonants seen in this data set?

3. Data from consonant classes

Data set: Arabic consonants

Debriefing

- What sound properties are used by the grammar?
  - *Hypothesis:* The basic phonetic properties that we reviewed for the quiz are **necessary** and **sufficient** to uniquely describe each class
- The hypothesis is **not** supported
  - The basic phonetic properties we reviewed are **not a very good model** of consonants in the human mental grammar

4. Data from vowel classes

Data set: Turkish

- Checking in: What information is provided in a "paradigm" data set like this?

4. Data from vowel classes

Data set: Turkish

Group discussion

- What determines the vowel in the **plural suffix**?

- What determines the vowel in the **genitive suffix**?

4. Data from vowel classes

Data set: Turkish

Debriefing

- What determines the vowel in the plural suffix?
  - **Two** phonologically active classes of vowels here
- What determines the vowel in the genitive suffix?
  - **Four** phonologically active classes of vowels here

4. Data from vowel classes

Data set: Turkish

- For each class in the data set: **Test the hypothesis!**
  - *Hypothesis:* The basic phonetic properties that we reviewed for the quiz are **necessary** and **sufficient** to uniquely describe each class
  - Can the quiz properties be used to…
    - give the class a **consistent description**?
    - **distinguish** the class from all other consonants seen in this data set?
  - What is the **smallest number** of vowel properties we need in order to do this?

4. Data from vowel classes

Data set: Turkish

Debriefing

- What sound properties are used by the grammar?
  - *Hypothesis:* The basic phonetic properties that we reviewed for the quiz are **necessary** and **sufficient** to uniquely describe each class
- The hypothesis is **not** completely supported
  - The basic phonetic properties we reviewed are **not the most efficient model** of vowels in the human mental grammar

5. The mental representation of segments

- Summary of discussion so far:
  - We want to build a **model** of how **segments** are **represented** in the mental grammar
  - We have evidence that **properties** of sounds matter to the mental grammar
  - But, the mental representation of properties needs to be (somewhat) different from the basic "set" we reviewed for the quiz

- The mental representation of a sound property is often known as a **phonological feature**

5. The mental representation of segments

- A **feature model** — part of our model of the phonological grammar
  - The set of sound properties *that we propose* as relevant for the phonological mental grammar
  - Subject to revision based on new evidence!
    - Is our model's behavior *(describe, predict, explain)* a good match for real-world data?
    - Make predictions and test hypotheses!

- **For next time:** Read "Phonological features" handout; practice with Arabic and Turkish (prep Qs)