Why do we say “razzle-dazzle” instead of “dazzle-razzle”? 

Language 
- Many levels 
  - grammar 
  - phrases 
  - words 
- All humans, who can, communicate through spoken language 
  - how does language depend on speech? 
  - what are the units of speech? 

Illusions 
- The “blurriness” of speech explains some long-held confusions 
  - Oronyms (Mondegreens) 

Illusions 
- When you hear what I say, you think you hear at least 
  - separate words 
  - separate syllables 
- But you do not 
  - words actually overlap in the speech signal 
  - it is nearly impossible to take a speech signal and cut it up into separate words 

Why the blur? 
- The ear is a bottleneck 
  - analogous to the critical flicker frequency in the eye 
  - the ear can distinguish <clicks> as separate only if they are given at less than 20 hertz 
    » 20 clicks per second 
  - above that, a series of clicks sounds like a continuous buzz 

But... 
- Speech is seemingly perceived much better 
- Normal speech provides 10 to 15 distinct phonemes each second 
- Fast speech is 20 to 30 phonemes per second 
- Artificially fast speech is 40 to 50 phonemes per second
Phonemes

- **phoneme** ˈfoʊ-ˌnem\ n
  [F phoneme, fr. Gk phonemat-, phonema speech sound, utterance, fr. phonein to sound](ca. 1916): a member of the set of the smallest units of speech that serve to distinguish one utterance from another in a language or dialect, the /p/ of *pat* and the /f/ of *fat* are two different phonemes in English.

Speech

- So what are phonemes?
- All speech is made of sounds
  - sound is a pattern of pressure on the ear
  - a tuning fork vibrates back and forth to make the sound of a pure tone
  - Frequency of vibration corresponds to pitch of the sound
- Speech consists of lots of patterns of this sort
  - With many different overlapping frequencies

Packing

- If the ear can only distinguish up to 20 sounds per second
  - and we can interpret speech that seems to contain 50 phonemes per second
  - then the speaker must be combining many phonemes together to overcome the limits of the ear
- The listener hears the 20 (or so) sounds in a second, but interprets them as more than 20 different phonemes

Phonemes

- Speech is made of phonemes
- Different combinations of phonemes correspond to different syllables and words
- We seemingly hear more phonemes than the ear can actually handle
  - how?

Packing

- If phonemes are being smashed together there must be some blurriness
  - and this can lead to misinterpretations
- This is also why computer speech sounds “funny”
  - The programs do not combine phonemes in the right way

Physiology

- Lungs push air out to make a sound
  - other organs shape sound
Example

- Note where your tongue is as you say
  - bet    butt
  - beet   bat
- The position of the tongue shapes the vocal tract and makes different sounds!
  - this is true for all vowels

Example

- Note what your lips do as you say
  - boot    book
- The lips add additional frequencies to make different sounds
- Thus, you can hear someone smile across a telephone!
- Vowels are all distinguished by the shape of the vocal tract

Consonants

- Consonants are more complicated
  - different type of control of air flow
- (1) Voicing: vibration of vocal cords
  - /β/, /ð/, /m/, /w/, /v/ (voiced)
  - /p/, /t/, /f/ (not voiced, or unvoiced)
- (2) Place of articulation:
  - /d/, /t/ (upper gum)
  - /m/, /b/, /p/ (lips)
  - /f/, /v/ (lip and teeth)

Consonants

- Some languages have other characteristics as well (e.g., tone, timing)
- For example, in English, the difference between /ba/ and /pa/ is the timing of the release of air for the consonant and the voicing of the vowel
- Voice Onset Time (VOT) is short for /ba/ and longer for /pa/
- CogLab data: sounds differ in VOT, judge if same or different sounds

Consonants

- (3) Manner of articulation
  - /d/, /t/ (stop)
  - /m/ (nasal)
  - /f/, /v/ (fricative)
- Each consonant is uniquely identified by its voice (or not) and its place and manner of articulation

Fun

- Why do we say razzle-dazzle instead of dazzle-razzle?
  - for phrases like this, people always first say the word with a leading consonant that impedes air flow the least
  - super-duper    willy-nilly    walkie-talkie    It's a rule!
  - helter-skelter    roly-poly    namby-pamby
  - harum-scarum    holy moly    wing-ding
  - hocus-pocus    herky-jerky    mumbo-jumbo
Phonemes

- English uses 22-26 (it depends on how you count) combinations of voicing, place, and manner of articulation (and 20 vowels)
  - Rotokas (Papua New Guinea) uses 6 (and 5 vowels)
  - Khoisian (Bushman) uses 141
    - Uses clicks as consonants
- No language uses some possible sounds
  - raspberries, scraping teeth, squawking,…
- Note, these sounds are used for communication, but not as part of language!
- Japanese does not distinguish /r/ from /l/

Rules

- To say a word, we must combine phonemes
- In every language there are rules (trees) that describe what phonemes can follow other phonemes
- Thus, we can identify possible words from impossible words
  - plast
  - ptak
  - vlas
  - rtut
  - thole
  - hiad
  - nypip
  - dnom

Compression

- Moving the tongue (and other articulators) around is difficult and takes time
  - to say sounds faster, people use coarticulation
  - shape tongue in advanced preparation for the next phoneme
  - this influences the sound of phonemes

Coarticulation

- We generally do not notice these adjustments
  - we are tuned to recognize the new sounds as coarticulation
- This is the main reason computers have a hard time recognizing human speech!

Coarticulation

- Notice that your tongue body is in different positions for the two /k/ sounds in
  - Cape Cod
- Note too, that the /s/ becomes /sh/ in
  - horseshoe
- And /n/ becomes /m/ in
  - NPR
- You can enunciate these “correctly”, but in casual speech you do not!

Coarticulation

- There are rules for how to coarticulate
- When a stop-consonant appears between two vowels, you do not actually stop
  - flapping
  - slapped --> slapt
  - patting --> padding
  - writing --> wriding
We have often observed that written language is different from spoken language.

George Bernard Shaw (among others) complained about spelling in English. He noted you could spell “fish” as “g-h-o-t-i.”

He offered a prize in his will for someone to create a good alternative to English spelling.

It is true that English spelling does not seem to agree with pronunciation, a problem for learning how to read!

Nor should it. If words were spelled the way they were pronounced, we would lose the visual connection between words.

It should not. If words were spelled the way they were pronounced, we would lose the visual connection between words.

- Slap --> slapped would become slapt
- Write --> writing would become wridding
- National Public Radio --> NPR would become MPR

There are other written forms of language that avoid some of these problems.

The most sensible written language is probably the Korean hangul.

Drawn characters indicate how consonants are pronounced.

Speech
Blurring
Phonemes
Articulation
Coarticulation
Spelling

Next time
- Learning language
- Babies
- Children
- Learning a second language
- CogLab on Age of Acquisition.

When should you learn a foreign language?