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

- 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

Illusions

- The “blurriness” of speech explains some long-held confusions
  - Oronyms (Mondegreens)
  - The stuffy nose can lead to problems.
  - The stuff he knows can lead to problems.
  - The good candy came anyways.
  - The good can decay many ways.
  - It’s a doggy-dog world.

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
  - [https://www.ispeech.org/instant-e-learning.text.to.speech](https://www.ispeech.org/instant-e-learning.text.to.speech)
Phonemes

- phoneme ˈfoʊ-nəm
  [F phonème, 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.

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 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

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”
  - https://www.ispeech.org/indirect-a-learning-text-to-speech
  - The programs do not combine phonemes in the right way

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

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
  - /b/, /d/, /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)

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

- CogLab data: sounds differ in VOT, judge if same or different sounds
  - 95 participants

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/
- Fun data: sounds differ in VOT, judge if same or different sounds
  - 95 participants

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
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
Spelling

- 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.

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.
  - slap --> slapped would become slapt
  - write --> writing would become wriding
  - National Public Radio --> NPR would become MPR

Other approaches

- 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.

Conclusions

- 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?