Phonotactic rules:
rules about what phonemes may be used in what positions.

E.g., English words may begin with /m/ and /n/ but not /ŋ/:
/mæp/ and /næp/ are words, but */ŋæp/ isn’t even a possible word.
There’s not a phonological rule turning /ŋ/ into something else in that position;
/ŋ/ just isn’t allowed in that position to begin with.

Different languages have different phonotactics:
many languages do allow initial /ŋ/: Vietnamese ñan ‘swan’.

Phonotactics are often related to syllable structure.

What is a syllable?
Roughly, a sequence of rising and falling sonority—
i.e., a cycle of opening and closing of the vocal tract.

A speech sound is more sonorous if produced with less vocal-tract obstruction:
e.g., sonorants are more sonorous than obstruents (hence the name).
The sonority hierarchy:
stops < fricatives < nasals < “liquids” < high vowels < low vowels
(“liquid” is a rough category usually including laterals and “r”-like sounds)

A sequence of speech sounds has a pattern of rising and falling sonority.
A syllable is each peak of sonority and the sounds surrounding it.

Take the word pretending /prətɛndɪŋ/:
Internal structure of syllables
- **Nucleus**: the vowel or syllabic consonant at the *sonority peak* of the syllable
- **Onset**: any phonetic material that *precedes* the nucleus
- **Coda**: any phonetic material that *follows* the nucleus
- **Rime**: the unit consisting of the nucleus plus the coda

Only the nucleus is mandatory; syllables may have no coda or no onset.

Hierarchical structure:
- syllable = onset + rime; rime = nucleus + coda

We can represent this hierarchical structure as a tree diagram (e.g., the syllable *please*):

```
    syll
   /---
  Ons Rime
   |    |
  pl  Nucl Coda
     i   z
```

Phonotactic rules often concern what **kinds** of syllables a language allows; this is a main source of phonotactic *differences between languages*.

**English** is very flexible about syllable structure; it can have syllables with
- **no onset or coda** (the word *owe* / o/)
- **clusters of three consonants** in the onset and coda (*strengths* / stɛŋθs/)
- in fact, **four-consonant clusters** in the coda (*texts* / tɛkts/)
- ...and anything in between

We can write this as (CCC)V(CCCC):
- up to 3 onset consonants, mandatory nucleus, up to 3 coda consonants.

Other languages are more restrictive in syllable structure:
- **Japanese** is (C)V(N): no onset clusters; only nasals are allowed in coda
- **Hawaiian** is CV: no codas at all, mandatory one-consonant onset

**CV** is the **most basic syllable structure**; it is found in all languages.

*Most* languages at least allow codas and/or make the onset optional.

Since CV is the most basic syllable structure, when consonants are between two syllables, they’re usually considered to be part of the **onset** of the **following** syllable if possible:

*magic* is syllabified as /mæ.dʒɪ.k/, not /mædʒ.i.k/

Consonant clusters are often bound by **sonority sequencing** rules:
- **onsets** typically **increase** in sonority; **codas** typically **decrease**.

Thus obstruent-sonorant clusters are allowed in English onsets (*club, three*), and sonorant-obstruent clusters in codas (*bulk, rant*), but not *vice-versa*.

There are subtleties—
- English has nasal-obstruent codas, but not obstruent-nasal onsets;
- some rules (e.g., no /dl/ in onsets) aren’t accounted for by sonority sequence;
- /s/ is often an exception to sonority sequencing, as in /s/ +stop onsets—but sonority sequence accounts for a large percentage of English phonotactics.

English has fairly permissive syllable structure, but some languages are more so:
- **Polish** has very complex clusters: /ɡɡbiɡ/ ‘back’; /mamotraftsf/ ‘of wastes’

English allows some **syllabic sonorants** in unstressed syllables, like *kitten*;

Imdlawn Tashlihiyt Berber is said to even allow syllabic *obstruents*. 
Above the syllable: **feet**

Syllables carry **stress**, but to describe how stress behaves, we use a larger unit: the **phonological foot**.

A **foot** is a unit consisting of **one or two syllables**, of which **one** is stressed.

In English, a foot consists of:
- a **stressed syllable** plus the following **unstressed syllable**, if any.
  (It doesn’t matter if the stress is primary or secondary stress.)

Thus there are two types of foot: **maximal** (2 syllables) and **minimal** (1 syllable).

An unstressed syllable not after a stressed syllable ends up **unfooted**.

The stressed syllable in a foot is called the **head** of the foot.
(Yeah, I know. I didn’t make up the name.)

**Examples:**
(In the examples, ácúte and gráve accents are used to represent prímàry and sécondàry stress.)
- Maximal feet: (Mìssï)(ssúppi), (légi)(slàtúre)
- Minimal feet: (bàm)(bóo), (bée̞f)(slèak)
- Maximal and minimal: (Tènme)(ssée), (intër)(vièw), (fàm)(táståc), (cú)(cùmber)
- Unfooted syllables: ba(nána), (àbra)ca(dábra), (Kàla)ma(zóo), (Wáshîng)ton

This gives a **deeper hierarchical structure** for **prosodic** units.
Example: the foot (and word) **badly**.

(Prosody is the branch of phonetics and phonology dealing with stress, rhythm, intonation, etc.)

![Diagram showing the hierarchical structure of prosodic units](image)

**Differences between languages:**

In some languages (such as English), the **first** syllable of a foot is the head;
in other languages, the head is the **second** syllable (if there are two).
(But a foot is **always** at most two syllables and has exactly one stress).

In English, stress is **phonemic**—i.e., not predictable by rule, stress for each word is learned on a case-by-case basis, minimal pairs exist (pérmit / permít), etc.

In many languages, there are **regular phonological rules** determining stress, so it is **predictable** and there are **no minimal pairs** distinguished by stress.

E.g., in French, stress is **always on the last syllable** of each word;
in Hungarian, it’s **always on the first**.
Thus stress in these languages is **allophonic**.
What role does foot structure play in English? i.e., how do we know that this structure is actually involved in the grammar?

Some segmental phonological rules depend on foot structure — e.g., English voiceless stop aspiration takes place at the beginning of a word or at the beginning of a foot:
Consider the three stops in Topeka—one word-initial, one foot-initial, one neither:
To(péka) [tʰəˈpʰiːkə]

Other rules are based on the interaction of feet with each other:

The rhythm rule:
when two primary-stressed feet would be adjacent, it’s possible to move the first primary stress back one foot to achieve better rhythm and avoid clash.
Examples:
• (Missi)(ssíppi) usually has primary stress on the second foot; but in (Missi)(ssíppi) (légi)(slàture) primary stress is on the first foot instead.
• (Nèw) (Yòrk), but (Nèw) (Yòrk) (Cíty)
Primary stress is moved back one foot, regardless of the number of syllables; if there isn’t a preceding foot, as in Ken(túcky), the stress can’t move back.

Expletive insertion:
inserting an “expletive” (i.e., a swear word) into the middle of another word — e.g. abso-bloody-lutely fan-fucking-tastic.
Expletive insertion must take place before primary stress and can’t break a foot:
(abso)(lútely) → (abso)(bloody)(lútely), but not *ab-bloody-solutely
(Missi)(ssíppi) → (Missi)(fùcking)(ssíppi), but not *Mi-fucking-ssississippi
For many speakers expletive insertion must be between two feet:
bā(nána) → ?ba-fucking-nana is questionable since the bā is unfooted.
When an unfooted syllable is in mid-word, expletive insertion is flexible:
(a-brə)ca(dábra) → (a-brə)cafucking(dábra) or (a-brə)(fùcking)ca(dábra)
Thus foot structure concisely explains both when expletive insertion can happen and when it can’t.