English Phonetics

English Obstruents
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*obstruents* are consonants that are formed by obstructing the airflow, causing increased air pressure in the vocal tract

*sonorants* involve no turbulent airflow in the vocal tract

the English obstruent consonants include the plosives, fricatives and affricates
• obstruents involve either a total closure of the vocal tract or a partial closure, i.e., a stricture causing friction
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  • *fricatives*, with only limited closure, i.e., a sufficient degree of closure to cause friction
  • *affricates*, with a total closure followed by a fricative release
• obstruents are typically voiceless, though voiced obstruents are common
## English Obstruent System

<table>
<thead>
<tr>
<th>Category</th>
<th>Vl.</th>
<th>Vd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plosives</td>
<td>p</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>d</td>
</tr>
<tr>
<td>Fricatives</td>
<td>f θ sʃ h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>v ʒ z ʒ</td>
<td></td>
</tr>
<tr>
<td>Affricates</td>
<td>tʃ dB</td>
<td></td>
</tr>
</tbody>
</table>

This table represents the English obstruent system, which includes plosives, fricatives, and affricates.
English Plosives

- English plosives consist of voiced and voiceless pairs of consonants
English Plosives

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• they occur at the labial, alveolar, and velar points of articulation
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• they occur at the labial, alveolar, and velar points of articulation
• there is also a glottal stop, that occurs in various positions in different dialects
• the labial plosives, /p/ and /b/, may have several different realizations in English
Labial Plosives

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• the aspiration is clear in the following spectrogram at 0.5-0.6s
• it appears as high-intensity noise in the range of 3,000-5,000Hz
'paper'
• the presence of aspiration in such forms is a crucial aspect of English phonetics
Foreign Accent

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• the word *peas*, as pronounced by a native speaker of English, clearly shows the aspiration from 0.05-0.1s
• it is absent in the pronunciation of the \[p\] (~0.06s) in the same word spoken by a French speaker
• this clearly marks a non-native speaker of English
English Speaker

French Speaker

English Obstruents
• the English voiceless bilabial plosive is not always aspirated
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• there is almost no turbulence following this until the vowel begins at 230ms
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• there is almost no turbulence following this until the vowel begins at 230ms
• this is typical of an English voiceless plosive after [s]
• there is a third variety that appears at the end of the syllable
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• all we can see is the labial effect on the vowel
• English also has a voiced bilabial plosive, [b]
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• for English, aspiration is a more significant marker of the distinction between voiced and voiceless obstruents
English speaker

French speaker

Stop Gap

Stop Gap

English Obstruents
Alveolar Plosives

• like the labial plosives, English has a contrastive voicing distinction among the alveolar plosives, /t/ versus /d/
Alveolar Plosives

- like the labial plosives, English has a contrastive voicing distinction among the alveolar plosives, /t/ versus /d/
- voiceless /t/ in initial position is aspirated, [tʰ], like voiceless /p/
• the same comments regarding aspiration of the \([p^h]\) hold for \([t^h]\)
• the same comments regarding aspiration of the \( \text{[pʰ]} \) hold for \( \text{[tʰ]} \).
• /t/ following [s] is unaspirated, thus [t], as shown in the word ‘store’.
• the same comments regarding aspiration of the \([p^h]\) hold for \([t^h]\)
• /t/ following \([s]\) is unaspirated, thus \([t]\), as shown in the word \textit{store}
• notice the absence of aspiration on the \([t]\) in \textit{store}, just as with the \([p]\) in \textit{spoons}
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if you compare this with the aspiration in \textit{toy}, it is easy to see the difference
as with the voiceless bilabial, there is also an unreleased version of /t/
• as with the voiceless bilabial, there is also an unreleased version of /t/ found at the end of the syllable

‘meet’
• as with the voiceless bilabial, there is also an unreleased version of /t/ found at the end of the syllable
• it is represented as [tʰ]
• in addition to these three phonetic realizations of /t/, there are also other variants that appear in certain dialects
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• they will be discussed later
before leaving the alveolar plosives, we should examine the voiced alveolar plosive, /d/
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• an example of English [d] is the word *dude*
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• compare the initial [d] in *dude* with the final [d]
• the final [d] is about 75ms long and its voicing bar reaches approximately 500Hz, much like [b]
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the voiced alveolar plosive may also appear as a flap [ɾ] in intervocalic position in NA English.
the velar plosives, voiceless /k/ and voiced /ɡ/, appear in the same varieties as the bilabial plosives
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in word- or syllable-initial stressed position, the voiceless velar plosive is aspirated, [kʰ]
• when preceded by [s], it has the same properties as the other plosives discussed so far, as shown by the spectrogram of *scoop*
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• note the brief aspiration from 190-215ms
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• note the brief aspiration from 190-215ms
• this is much less than for *call*, where aspiration ranges from approximately 35-90ms
Glottal Stop

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- one final stop acts as an allophonic variant of /t/ in some contexts
- the glottal stop is invariably voiceless
- when producing [ʔ], the vocal cords are held tightly together, preventing vibration
- the glottal stop is realized as a gap in the flow of sound, as in the London form for *little*
• [ʔ] may also occur as preglottalization on consonants at the end of the syllable

a. quite good  \([kwɑʈ ˈɡʊd]\)
b. look down  \([luʔk ˈdɔŋ\]
c. happen  \([hæʔpəŋ\]

English Obstruents
• the final use of glottal stop appears in North American English, and is similar to the case of preglottalization
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• it applies to forms having a syllabic alveolar nasal preceded by a voiceless alveolar plosive
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• it applies to forms having a syllabic alveolar nasal preceded by a voiceless alveolar plosive
• words like button, cotton, and kitten, but not in sudden, happen, bottom, little, or butter
• it only happens with syllabic alveolar nasals preceded by voiceless alveolar plosives
• a spectrogram of the word button, [bʌʔn] shows this:
English Fricatives

• English fricatives include \([f, \theta, s, \mathbf{s}, h, v, \mathbf{ð}, z, ʒ}\)
English Fricatives

- English fricatives include [f, θ, s, ʃ, h, v, ð, z, ʒ]
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English Fricatives

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• few languages have so many contrastive fricatives
English Fricatives

• English fricatives include [f, θ, s, ʃ, h, v, ʒ, z, ʒ]
• this is a large set of fricatives typologically
• few languages have so many contrastive fricatives
• Korean has only two, or three, depending on the dialect: [s, s’, h]
there are two contrastive labiodental fricatives in English, the voiceless [f] and the voiced [v]
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• words such as *fox*, *file*, and *frame* begin with [f], while *tough*, *half*, and *stuff* end with [f]
Labiodental Fricatives

• there are two contrastive labiodental fricatives in English, the voiceless [f] and the voiced [v]
• their typical properties include high frequency turbulence concentrated above 4,000 Hz
• words such as fox, file, and frame begin with [f], while tough, half, and stuff end with [f]
• there is no voicing bar with [f]
English Obstruents
• the voiced labiodental fricative also exhibits high frequency turbulence concentrated above 4,000 Hz
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• there is a substantial voicing bar occupying approximately the lower 400 Hz
• the voiced labiodental fricative also exhibits high frequency turbulence concentrated above 4,000 Hz
• there is a substantial voicing bar occupying approximately the lower 400 Hz
• words beginning with [v] include *vie, valve* and *view*, while words ending with [v] include *halve, live* and *cove*
• Interdental fricatives are not common in the languages of the world
Interdental Fricatives

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- English has both voiceless and voiced variants
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• [θ] is found as the first sound in words such as think, thigh and thought
• Interdental fricatives are not common in the languages of the world
• English has both voiceless and voiced variants
• [θ] is found as the first sound in words such as *think*, *thigh* and *thought*
• as the last sound of words such as *both*, *path* and *with*
- Energy begins low (2500hz)
• the voiced counterpart, [ð], occurs as the first sound in words such as *though*, *that* and *they*
• the voiced counterpart, [ð], occurs as the first sound in words such as *though*, *that* and *they*
• as the last sound in words such as *bathe*, *betroth* and *soothe*
• English also has alveolar fricatives, [s] and [z]
English also has alveolar fricatives, [s] and [z] and they are the most common crosslinguistically.
English also has alveolar fricatives, [s] and [z]
the most common crosslinguistically
the bulk of the turbulence occurs above 3500Hz
• With [z] there is a voicing bar

[aza]
• English has both voiceless and voiced alveopalatal fricatives, [ʃ] and [ʒ]
Alveo-Palatal Fricatives

• English has both voiceless and voiced alveopalatal fricatives, [ʃ] and [ʒ]
• the range of turbulence for both of these is from around 2000 Hz up to 10,000 Hz
[a3a]
• the final English fricative is voiceless glottal [h]
• the final English fricative is voiceless glottal [h]
• there is no voicing bar for [h]
• the final English fricative is voiceless glottal [h]
• there is no voicing bar for [h]
• its turbulence appears to be strongest around 1,000 Hz
Sibilants

• fricatives can be divided into sibilants versus non-sibilants
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• this distinction appears in the rules for forming the plural and other rules involving a suffix with the shape /-s/ or /-z/
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Sibilants

• fricatives can be divided into sibilants versus non-sibilants
• this distinction appears in the rules for forming the plural and other rules involving a suffix with the shape /-s/ or /-z/
• sibilants involve a turbulent airstream that strikes an obstacle, such as the teeth
• non-sibilants involve turbulence generated at the site of the constriction
sibilants tend to be louder than their non-sibilant counterparts
Sibilants 2

• sibilants tend to be louder than their non-sibilant counterparts
• most of their acoustic energy occurs at higher frequencies
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• for instance, [s] has acoustic energy starting at around 3,500 Hz, and reaching as high as 10,000 Hz
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• for instance, [s] has acoustic energy starting at around 3,500 Hz, and reaching as high as 10,000 Hz
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• the English sibilants include [s, ŋ, z, ʒ]
# Fricative Properties

<table>
<thead>
<tr>
<th>Fricative</th>
<th>Frequency Range</th>
<th>Intensity</th>
<th>Voicing Bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>5000Hz and above</td>
<td>low</td>
<td>no</td>
</tr>
<tr>
<td>v</td>
<td>5000Hz and above</td>
<td>low</td>
<td>yes</td>
</tr>
<tr>
<td>θ</td>
<td>2,500Hz and above</td>
<td>low</td>
<td>no</td>
</tr>
<tr>
<td>ð</td>
<td>2,500Hz and above</td>
<td>low</td>
<td>yes</td>
</tr>
<tr>
<td>s</td>
<td>3,500Hz and above</td>
<td>high</td>
<td>no</td>
</tr>
<tr>
<td>z</td>
<td>3,500Hz and above</td>
<td>high</td>
<td>yes</td>
</tr>
<tr>
<td>ß</td>
<td>2,000Hz and above</td>
<td>high</td>
<td>no</td>
</tr>
<tr>
<td>ð</td>
<td>2,000Hz and above</td>
<td>high</td>
<td>yes</td>
</tr>
<tr>
<td>h</td>
<td>750Hz-3000Hz</td>
<td>low</td>
<td>no</td>
</tr>
</tbody>
</table>
the English affricates include both voiceless, [ʧ], and voiced, [ʤ], alveopalatal affricates
English Affricates

- the English affricates include both voiceless, [ʧ], and voiced, [ʤ], alveopalatal affricates
- *lecher* illustrates the voiceless alveopalatal affricate, [ʧ] and *ledger* shows the voiced variant, [ʤ]
lecher  ledger
The End