

## The Aerodynamics of Nasality - Ham strips and dump stores.

This is an exercise on coarticulation and the relative timing of gestures. We will be looking at recordings of two sentences.

- (1) Don't cut my hamster into ham strips.
- (2) The alley dumpster is like a dump store.

In language history it is not unusual to find that sequences like [VmsV] come to be pronounced [VmpsV] (see Ohala, 1997 for examples). The explanation for this cross-linguistic tendency for the development of "emergent stops" is that the relative timing of the gestures involved in producing the [m] and [s] is variable so that sometimes the velopharyngeal port shuts (closing the nose) before a fricative opening is formed at the alveolar ridge. This results in a brief amount of complete vocal tract closure - an (emergent/excrescent/epenthetic) stop. You'll be examining "hamster" and "ham strips" for evidence of emergent stops, using "dumpster" and "dump store" for comparison. One question that we are interested in answering is whether we can determine if the emergent stop is "a purely phonetic entity" (Ohala, 1981), and hence perhaps best described as an "excrescent stop", or if the stop has been phonologized, becoming part of the lexical representation of "hamster" for our speaker

In addition to exploring the emergence of stops in nasal fricative sequences, we will be exploring the spread of nasality onto preceding vowels, and the assimilation of [t] to a following [m].

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1) Set up WaveSurfer by adding a new configuration file to your system. This exercise uses WaveSurfer to display multi-channel recordings for analysis and measurement. WaveSurfer can be customized for particular analysis tasks and the configuration file "Aerodynamics.conf" which is a part of the .zip directory of files that accompany this exercise, customizes WaveSurfer to display the data files that we provide for this exercise. Copy this configuration file into your computers' .wavesurfer configuration directory.

- a) On Linux and MacIntosh computers this is done in a terminal window with this command:  
> cp Aerodynamics.conf ~/.wavesurfer/1.8/configurations/
- b) In Windows copy the configuration file to the .wavesurfer directory in a command window:  
copy Aerodynamics.conf C:\.wavesurfer\1.8\configurations\

2) Start WaveSurfer and select "Aerodynamics" as the default configuration for reading files.

File -> Preferences

Use configuration: select "Aerodynamics"

File -> Open

pick one of the files in the "nasality" directory to confirm that the configuration is set.  
(the display should look like figure 1 on the next page).

3) Fill the "Chooser" with a list of files to look at.

File->Chooser Add files..:

and select by hand all 22 of the \*.wav files in the "nasality" directory.

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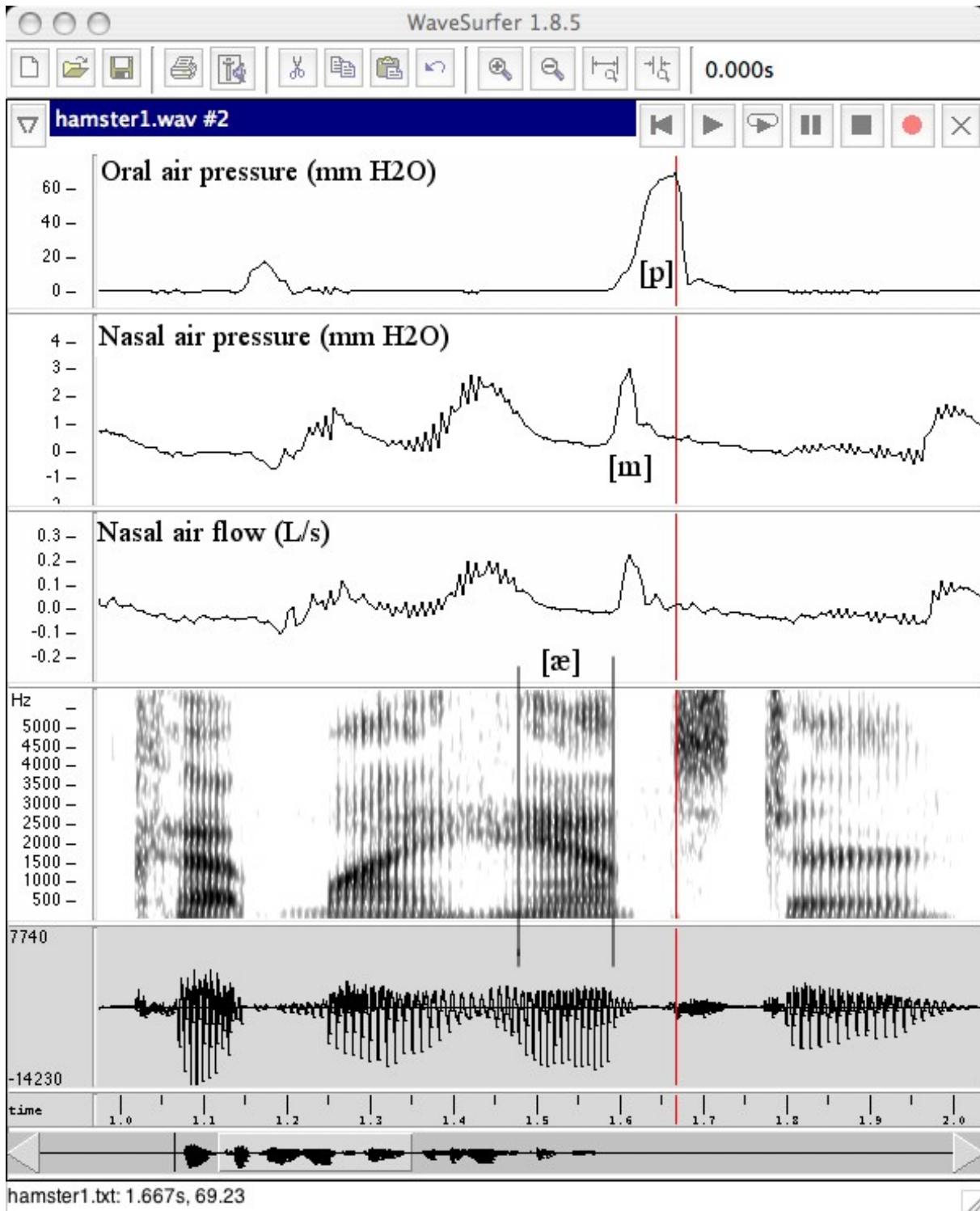


Figure 1. "cut my hamster" from utterance "hamster1.wav". This example has an emergent stop.

Figure 1 shows the words "cut my hamster" from the utterance "don't cut my hamster into ham strips". The cursor is located at the peak of oral air pressure during the /m/ of "ham" which in this utterance has an emergent stop. Nasal airflow and air pressure are decreasing at the time of the oral air pressure peak and the fricative noise (seen in the spectrogram) is just beginning.

Q1. Examine the phrase "ham strips" in hamster1.wav. Listen to it also! Did the speaker produce an excrescent stop in "ham strips"? What aspects of the data did you rely on to make this determination?

Q2. Compare the /ms/ sequences in hamster1 with the /mps/ sequences in dumpster2. How is the word "dumpster" different from the word "hamster"? What about "dump" and "ham"?

Now we'd like for you to take four measurements from each of the 22 Aerodynamic recordings. Measure the duration of the (first) vowels in "hamster", "ham", "dumpster" and "dump", and measure the peak oral air pressure in the [m(p)] sequence in each of these four words. These measurements are illustrated in | Figure 1. You can organize your data in a table like this (we filled in the first row):

	hamster vowel dur	pressure	ham vowel dur	pressure	dumpster vowel dur	pressure	dump vowel dur.	pressure
1,2	122	69	114	43	108	63	84	65
...								
21,22	124	60						

Plot the duration values on the horizontal axis and the pressure values on the vertical axis.

In R you can do this with these commands:

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hamster.dur = c(122, ... ,124)
hamster.p = c(69, ... ,60)
plot(hamster.dur, hamster.p, ylim=c(20,75), xlim=c(100,150), xlab="ms", ylab="mm H2O")
points(ham.dur, ham.p, pch=2)
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Q3. Which points in the graph correspond to cases of emergent stops and which seem to have weak or no stops at all? Can you predict from the duration of the vowel whether there will be an emergent stop or not?

Q4. Refer to Ohala (1981) and comment on the relationship between vowel duration in "dumpster" and "dump" and vowel duration in "hamster" and "ham". On the basis of vowel duration patterns, Ohala concluded that the epenthetic stop in made up words like "clamster" is a "purely phonetic entity". Does the same seem to be true for the [p] in "hamster"?

Q5. Select an instance of dumpster?.wav and examine the nasal pressure (and flow) measurements in the vowels in "dumpster" and "dump". Are these vowels nasalized? What is happening with the mouth during the vowel (beyond whether the velopharyngeal port is open)? What effect will the articulation of the vowel have on the volume of the nasal cavity?

Q6. Select an instance of hamster?.wav and examine the nasal pressure (and flow) measurements in the vowels in "hamster" and "ham". Are these vowels nasalized? How is the sentential context of these words different from the context in the "dumpster" sentence?

Q7. While you have a hamster file open look at the words "cut my". Has the [t] assimilated in place of articulation to the [m]? How is this instance of [p] different from the [p] in "strips"? Should it be transcribed [p]?