Experiment 6: Lexical biases in speech perception

1 Introduction

This experiment measures how the listener's knowledge of what is and is not a word in their native language influence their perception of individual speech sounds. If we were to create a series of sounds that vary incrementally from [d] to [t] in the context [_in], English listeners would identify about half the stimuli as "d" and the other half as "t" because both *dean* and *teen* are words. (Such a series of stimuli is called a "continuum" below, because adjacent stimuli differ by small, nearly undetectable amounts from one another.) However, if the context were instead [_ip], then they would identify noticeably more than half the stimuli as "d" because *deep* is a word in English, but **teep* is not. However, if the context were instead [_itʃ], they would identify noticeably less than half of the stimuli as "d" because **deach* is not a word but *teach* is. In the contexts [_ip] and [_itʃ], we say that listeners exhibit a "lexical bias" because they prefer to give the response that makes a word with the context rather than a non-word. The speech signal is often degraded by competing sounds, so listeners have to make decisions about what they have heard using incomplete and imperfect information. It is therefore entirely unsurprising that their decision would try to make sense rather than nonsense out of the signal, when given the choice between sense, an existing word, and nonsense, a nonword. Lexical biases of this kind have been found in a great many experiments. Here, you are going to try to replicate those results.

2 Methods

2.1 Stimuli

The stimuli in this experiment are made by first replacing the burst of a voiceless unaspirated stop with that of a voiceless aspirated stop and then adding increasing longer stretches of the aspiration interval step-by-step.[1] Doing so creates continua of voice onset times (VOT) that start with a voiceless unaspirated stop, that will be identified as "b", "d", or "g", and end with a voiceless aspirated stop, that will instead be identifed as "p", "t", or "k". Intermediate steps along these continua will sound ambiguous between "b" versus "p", "d" versus "t", or "g" versus "k". It is these ambiguous stimuli that we expect to show the lexical bias effects; that is, a listener should identify the ambiguous stimuli more often with the word than the non-word alternative.

The first step in constructing each continuum is to replace the burst of the original voiceless unaspirated stop with that of the voiceless aspirated stop. Subsequent steps increase the delay in voice onset incrementally by replacing successive periods of the vowel following the original [b] with intervals of aspiration of equal duration, until an interval of aspiration long enough to convey a voiceless aspirated stop is obtained. There are three

[1] We will make the stimuli for you.

groups of experimenters for this experiment, each one looking for evidence of lexical biases in listeners' responses to a VOT continuum for a different place of articulation.

2.1.1 Bilabial

The bilabial group will test a [b-p] continuum in the contexts:

_itʃ No lexical bias is expected because both *beach* and *peach* are words.
_if Bias toward "b" is expected because *beef* is a word but **peef* is not.
_is Bias toward "p" is expected because *peace* and *piece* are words but **beace* is not.

2.1.2 Alveolar

The alveolar group will test a [d-t] continuum in the contexts:

_in No lexical bias is expected because both *dean* and *teen* are words.
_ip Bias toward "d" is expected because *deep* is a word but **teep* is not.
_itʃ Bias toward "t" is expected because *teach* is a word but **deach* is not.

2.1.3 Velar

The velar group will test a [g-k] continuum in the contexts:

_ɪl No lexical bias is expected because both *gill* and *kill* are words.
_ɪft Bias toward "g" is expected because *gift* is a word but **kift* is not.
_ɪs Bias toward "k" is expected because *kiss* is a word but **giss* is not.

For each place of articulation, the continua are exactly the same, so only the contexts differ.

2.2 Procedures

2.2.1 Collecting data

Before beginning, make sure to download and install the latest version of Praat from:

www.praat.org

I cannot guarantee that the experiment files will run with earlier versions.

Then, you need to download three files from the website:

experiments.zip
stimuli.zip
templates.zip

Experiments.zip contains three files:

b_p.exp	The Bilabial Group uses this one.
d_t.exp	The Alveolar Group uses this one.
g_k.exp	The Velar Group uses this one.

This .zip file also contains instructions that you should give to your participants to read before beginning the experiment. There are separate sets of instructions for each experiment, so use the one that appropriate for yours.

Stimuli.zip contains the stimuli for all three experiments. They are zipped together in a folder called “Sounds”. Make sure that when you unzip them, they are in a subdirectory (folder) called “Sounds” (note the uppercase “S”) under the directory (folder) to which you downloaded the .exp files.

To run the experiment, you open your .exp file in Praat, using “Read from file...” from the Read menu. This will put the .exp file in the object list. Select it, and click on Run in the Menu to the right. This will open up the experiment onto your screen. You should do this before your participants sit down in front of the machine, so that the experiment is ready to run when they sit down. The screen will say “Click anywhere to start.”

Once they click, the screen will change to display two yellow boxes with letters in them corresponding the possible responses in the experiment, “b” and “p”, “d” and “t”, or “g” and “k”. At the top of the screen, is a question: “Is the first consonant b/d/g or p/t/k?” A stimulus will play immediately after they click as well. They should click in the box that corresponds to the first consonant they hear. Shortly after they respond, the next stimulus will be presented, and again they should click in the box corresponding to its initial consonant.

Four times in the course of the experiment, a screen will appear saying, “"Please relax for a moment. Click anywhere to continue." This gives them a chance to rest for a moment before continuing. These rest periods occur every 72 trials; there are a total of 360 trials altogether. When I ran it on myself, it took just 12 minutes to run all 360 trials, so your participants should not get too bored. (A little counter shows progress in the upper left hand corner of the screen. Do not draw your participants’ attention to it.)

Finally at the end of the experiment, a message appears saying, "The experiment is over. Thank you for participating." Once the participants are done, you should explain to them what the experiment is about and answer any questions they might have.

Once the experiment is over, you close the experiment window using Close Window under its File Menu. Then return to the Objects box and click on Extract Results from the menu to the right. Select the resulting object and click on Collect to Table from the menu on the right. Once again, select the resulting object and click on “Write to Table file” from the Write menu. Give the file a name that identifies its contents. The name should identify the

experiment, e.g. with the string “b_p” for the bilabial experiment, and the participant, e.g. with the string “ab” for the first listener run. This creates a file that can be opened in Excel.

Although we cannot use you as listeners, because you know the purpose of the experiment, you should run the entire experiment on yourselves before running it on anyone else, so that you know what the experience is like.

2.2.2 Analyzing the data

Open the files for each participant in Excel. As they are text files, they will have to be converted to Excel formant in the usual way. Once they are opened in Excel, you will see three columns of data. The first identifies the experiment, the second the stimulus presented on each trial, and the third the response the participant gave to that trial. Also open the template for your experiment and select columns D-AJ from it. Copy and then paste those columns into the corresponding columns in each of your data files. Then before doing anything else, save the results as Excel files.

Your results are in cells E367:E369, and also in cells E372:G381. In cells E367:E369 are the total proportions of “voiced” responses (that is, we tally “b”, “d”, or “g” responses) given to all the stimuli from a particular continuum (the continuum is identified to the left), while in cells E373:G381 are the proportions of “voiced” responses given to each stimulus in each continuum (the continuum is identified above and the stimulus to the left). I will demonstrate in class how to produce a chart of the data in cells E372:G381.

3 Analyzing and writing up results

Once all members of each lab group have collected responses from three listeners, all the values representing the total proportion of “voiced” responses across the continuum obtained from each listener (the values in cells E367:E369) should be pooled and averaged. You should also calculate confidence intervals for these averages using the procedure described for the nasalization lab, so that you can compare the averages with one another. The total proportion of “voiced” responses should be greatest in the contexts:

_if Labial group
_ip Alveolar group
_ɪft Velar group

least in the contexts:

_is Labial group
_itʃ Alveolar group
_ɪs Velar group

and in-between in the contexts:

_itʃ Labial group
_in Alveolar group
_ɪl Velar group

Or, in other words, the contexts should be ordered in terms of the proportion of “voiced” responses as follows for each group:

Labial: _if > _itʃ > is
Alveolar: _ip > in > _itʃ
Velar: _ɪft > _ɪl > _ɪs

Your write-up should show your results and discuss whether they conform to these expectations, or if not, how they deviate from them.