Phonetic stimuli manipulation in Praat

Contents

1. Overview

This guide explains how we are going to change and manipulate recordings using Praat functions and Praat scripts. These recordings are going towards two different experiments. The first experiment is a 'vowels-only' experiment, where we will be dealing with monosyllabic word pairs (e.g., *big dad, kick back*) and changing all the KIT and TRAP vowels to create four stimuli per word pair. The second experiment is a 'vowel-and-t' experiment, where we will be dealing with disyllabic word pairs (e.g., *dotty butter, cabin party*) and changing all the TRAP and intervocalic /t/ sounds to create four stimuli per word pair. For both experiments, we are exploring how much listeners use multiple phonetic sounds together (i.e., KIT and TRAP together or TRAP and intervocalic /t/ together) to rate a speaker on different social dimensions.

Table 1 and Table 2 below show the target and filler stimuli for each experiment. The goal is to have four sound files of each of the target word pairs per speaker (there are six speakers). You will also be required to select the best sounding/looking filler stimuli, but this won't require any manipulation.

Table 1. All stimuli for the vowel-only experiment. The first column highlights all the recorded target stimuli for word pairs that have both KIT vowels (hence, KIT-KIT), etc.

Target KIT-KIT word pairs	**Target KIT-TRAP** word pairs	**Target TRAP-KIT** word pairs	**Target TRAP-TRAP** word pairs	**Filler** (same vowel) word pairs	**Filler** (different vowel) word pairs
Big kid	Big Dad	Bad bid	Bad Dad	Large farm	Bored guard
Big pick	Big bag	Bad kid	Bad bag	Large shark	Large hawk
Big kick	Big gap	Bad gig	Bad back	Large yard	Large pawn
Big fig	Big pack	Bad kick	Bag tag	Calm guard	Fourth cup
Thick pig	Big tap	Bad pig	Bad tap	Fourth hawk	Wrong board
Big pig	Kick Dad	Bad fig	Back pack	Tough love	Tough guard
Dig big	Kick back	Back kick	Tag back	Love Mum	Bug park
Kid dig	Pick Dad	Tad big	Bad cap	Fun bug	Dug yard
Pig dig	Pick pack	Bad pick	Cab back	Mud fun	Mud yard
				Mum cup	Long yard
				Calm mum	Large sum
				Cop nod	Bored nun
				Tough nun	Fourth guard
				Fun nun	Bored mum

Table 2. All stimuli for the vowel-and-t experiment. 'T' indicates the word pairs that have intervocalic /t/. You'll notice the vowel labels, START, LOT, and STRUT in the TRAP-T and T-TRAP columns, this lets us know what the stressed vowel is in that particular intervocalic /t/ word.

Target **TRAP-TRAP** word pairs	**Target** **TRAP-T** word pairs	**Target** **T-TRAP** word pairs	**Target** **T-T** word pairs	**Filler** (same vowel) word pairs	**Filler** (different vowel) word pairs
Badder bagger Badder dagger Badder cabin Tagger cabin Dapper dagger Backer cabin Dapper cabin Cabin dagger Cabin tagger	*START* Badder party Baggy garter Dagger party Dapper party Cabin party *LOT* Badder cotton Baggy cotton Baggy bottom *STRUT* Cabin gutter	*START* Party dagger Party cabin *LOT* Dotty dagger Bottom cabin Dotty cabin Bottom baggy Bottom dagger Cotton cabin *STRUT* Butter bagger	Dotty garter Dotty butter Tarty butter Party garter Party cotton Party button Dotty cotton Bottom cotton Cotton button	Darker farmer Larger garden Robber robin Calmer farmer Foggy robber Foggy robin Darker karma Darker garden Darker parka Farmer garden Farmer Parker Calmer garden Larger farmer Larger parka	Darker robin Muddy garden Foggy garden Tougher farmer Muddy parka Larger robin Farmer Robin Darker border Calmer robber Calmer robin Tougher parka Larger border Muddy farmer Tougher robber

1.1 Notes

- You will only be required to manipulate the sound files from the P_ folders (P_01, P_04, P_05, P_06, P_07, P_08).
- In this document: every time an instruction tells you to click or interact with something, the thing to click or interact with is in orange text. Reference to file names and stimuli names are in green text.
- For each sound file, the speaker repeats the word pair a minimum of four times. Throughout this document, I refer to these as **repetitions**.
- Not all the word pairs will be used in the experiments, so it is okay if some word pairs manipulate worse than others.

2. Pre-manipulation

2.1 Set-up

- Transfer the wav files from the hard drive to an appropriate place on your device.
- Transfer the Praat scripts that are there to an appropriate place.
- Download Praat (if you don't have it already) https://www.fon.hum.uva.nl/praat/download_win.html
- Download Praat vocal toolkit and save in appropriate place - https://www.praatvocaltoolkit.com/download-installation.html

- You'll need to run through the instructions here to set up the vocal toolkit to add to Praat.

2.2 Adding buttons

We can add three of the Praat scripts as buttons in Praat which we can click to run the script instead of loading in the script every time. We only need to do this once.

1. Load in a .wav and .TextGrid file (any file will do).
2. Click both files and select View & Edit.
3. When the Praat window opens, click File>Open Editor Script… and open the 'vowel_duration4' script.
4. In the script, click File>Add to Menu…
5. A prompt will pop up and we want to change the 'Menu' textbox to say Edit and the 'Command' textbox should be something related to the script, so for this script, let's put Change vowel duration.
6. Click OK.
7. Close the Praat window and reopen the .wav and .TextGrid file together. Click Edit and down the bottom there should be the new button you made called 'Change vowel duration'.

Repeat steps 1-7 **but** do not load in a .TextGrid file for the 'shorten_s_from_TG' script (i.e., we only need to load in the .wav file to make this button) – call this button Shorten s.

3. Vowels-only target stimuli

This section tells us how to make the target stimuli for the first experiment. For this experiment, we are only dealing with KIT and TRAP in monosyllabic word pairs. I use the word pair 'big dad' as an example here.

In brief, there are six main steps:

- Finding, notetaking, and saving the best words.
- Changing the vowel duration.
- Manipulating the vowel.
- Adding silence and saving.
- Concatenating all possible combinations.
- Reorganising.

To start

- Open Praat, click Open>read from file and load in silence-0_3.wav.
- Open the Google sheets I have shared with you. You will fill this out as you go (https://docs.google.com/spreadsheets/d/1DyLgJcfsZN2NiLOdZEZ4lQnsGKHz9tBBQV5TznUQcKM/edit?usp=sharing).

3.1 Finding, notetaking, and saving the best words

1. Click Open>read from file and load in a .wav file and it's corresponding .TextGrid file from a participant's recordings folder (both files will be saved as something like this: p_01-20240522-1109-49__0_6_741375).
2. Select both files in Praat and click View & Edit.
3. If your formant tracking is turned off, click Formants and check Show formants.
4. If your pulse tracking is turned off, click Pulses and check Show Pulses.
5. Have a look and listen to each word pair utterance up close. We want to pick the best sounding words from different **repetitions** (i.e., the first and second word cannot come from the same repetition). Follow this guide to decide which repetition of the word should be picked:
    - Clear formant tracking with minimal red dots missing and the formant line is mostly smooth across the vowel.
    - Visible pulses.
    - Proper pronunciation of sounds there (e.g., some instances might be rhotic (which we don't want)).
    - Avoid creaky sounding instances.

- Nothing too short (especially for KIT, see Table 3). I tend to pick the longest KIT and TRAP.
- Avoid plosive 'popping' as much as possible.
- Avoid hesitations.
- Avoid breaths/mouth noises that are quite loud.
- Good volume.

6. When you find the best first word, select the full word (by clicking the whole word in the tier), and click Sound>Extract selected sound (time from 0), then click TextGrid>Extract selected TextGrid (time from 0).
7. Repeat steps 5-6 for the second word.
8. Write in the Google sheet which repetition (1-4) each word came from in the relevant columns.
9. You'll notice four new files in Praat, these are the words you extracted (in order) so we should rename them appropriately. Select the first file and click Rename… Rename these files as *word-participantid* (e.g., big-p05 for both the sound and TextGrid file, dad-p05 for both the sound and TextGrid file).
10. Save these files to the participant's original folder. To do this, select the sound file and click Save>Save as WAV file… Repeat with the second word. For the TextGrid files, select the TextGrid file and click Save>Save as text file… Repeat with the second word.
11. Remove these from Praat (avoid removing the silence-0_3 file) by selecting all four files and clicking Remove…

Table 3. Mean vowel durations for each speaker for each vowel and a mean duration for every speaker except p_01 (shortest vowel means) and p_04 (longest vowel means). We want to mostly focus on the 'GROUP' mean when deciding whether the length of a vowel is good or not, remembering that being longer than the mean is better than being shorter.

Speaker	Vowel	Mean duration	Mean duration (3dp)
p_01	KIT	0.05655462	0.057
p_04	KIT	0.11020833	0.110
p_05	KIT	0.08422594	0.084
p_06	KIT	0.08579167	0.086
p_07	KIT	0.08694561	0.087
p_08	KIT	0.08930328	0.089
p_01	TRAP	0.09759777	0.098
p_04	TRAP	0.14638889	0.146
p_05	TRAP	0.11894444	0.119
p_06	TRAP	0.11594444	0.116
p_07	TRAP	0.11874652	0.119

p_08	TRAP	0.13509537	0.135
GROUP (excl. p_01, p_04) – mean of means	KIT	0.086566625	**0.087**[1]
GROUP (excl. p_01, p_04) – mean of means	TRAP	0.1221826925	**0.122**

3.2 Changing the vowel duration

If the vowel is quite short (especially for KIT), we want to lengthen it. Typically, if the KIT vowel is shorter than 0.06ms we will want to lengthen it (probably no longer than 0.015ms). TRAP vowels aren't usually short, but we don't want any TRAP vowels shorter than 0.09ms. These can be lengthened up to 0.25ms (we priorities long vowels over shorter ones). We can shorten TRAP vowels if they are longer than 0.4ms. This step can be skipped if the duration is good.

12. Reopen the .wav and .TextGrid files that you just saved in the original folder.
13. To change the duration of a vowel, select the sound and TextGrid files and click View & Edit
14. To lengthen a vowel
    - select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Increase the vowel to the length you want it to be.
    - You'll notice a new folder has been created in your files that is called durmod, this has the new duration file.
15. To shorten a vowel
    - select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Decrease the vowel to the length you want it to be.
    - You'll notice a new folder has been created in your files that is called durmod, this has the new duration file.
16. We can change the duration of the vowel multiple times if we find that one length doesn't work well in manipulation. When you find the best length (i.e., the one that produces the best vowel manipulation in Section 3.4 below) note this in the Google sheet as either 'lengthen-(duration you lengthened it to)', 'shortened-(time you shortened it to)', or 'nochange' (if you didn't change the vowel's duration).

[1] Definitely nothing shorter than 0.06ms for KIT. I find I can also make KIT quite a bit longer than 0.087ms – I would say 0.13ms max.

3.3 Manipulating the vowels

There are five different ways we can manipulate the vowels. We try these in the order below to see which one works best, starting with a, then b, then c, etc…

a. Plug-in
b. Plug-in + voicelesss
c. Script
d. Script + extending boundary
e. Script + extending boundary + voiceless

Let's go through these one-by-one.

a. Plug-in

17. We can begin changing the vowel formants start by opening up the first word (.wav file and .TextGrid file).
18. First, we want to identify the best Hz setting for tracking the vowels, click Formants>Formant settings… You'll find that the default setting is 5500Hz. See if raising or lowering this number makes the formant tracking (the red dots) more accurate (I would try 4500, 5000, 5500, 6000, and 6500).
19. Once you find the best Hz level, note this down somewhere and return to the Praat window.
20. Now, we select the sound file we want to manipulate and click Process>Change formants… (which is on the right-hand side of the screen under the Vocal Toolkit heading).
21. A dialogue box will appear. We want to change the F1 and F2 mean values by referring to Table 4 below, entering either the innovative values to make the innovative manipulation or the conservative values to make the conservative manipulation. These values are different depending on whether you are manipulating a KIT or TRAP vowel. For example, if I want to make the innovative manipulation for big-p05, I will enter the KIT value **518** into New F1 mean (Hz) textbox and enter the KIT value **1506** into the New F2 mean (Hz) textbox.

Table 4. Vowel manipulation formant values and example renames.[2]

	KIT innovative	KIT conservative	TRAP innovative	TRAP conservative
Mean F1	518	423	496	606
Mean F2	1506	1841	1980	1619

22. Next, we want to enter **0** into the New F3 mean (Hz).
23. Next, we want to enter the Hz value we determined in step 18 into the Maximum formant (Hz) textbox.
24. Finally, we untick the Preview (Apply. Uncheck to publish) box so that the manipulated file is added to the Praat window. See Figure 1**.**
25. Click OK.

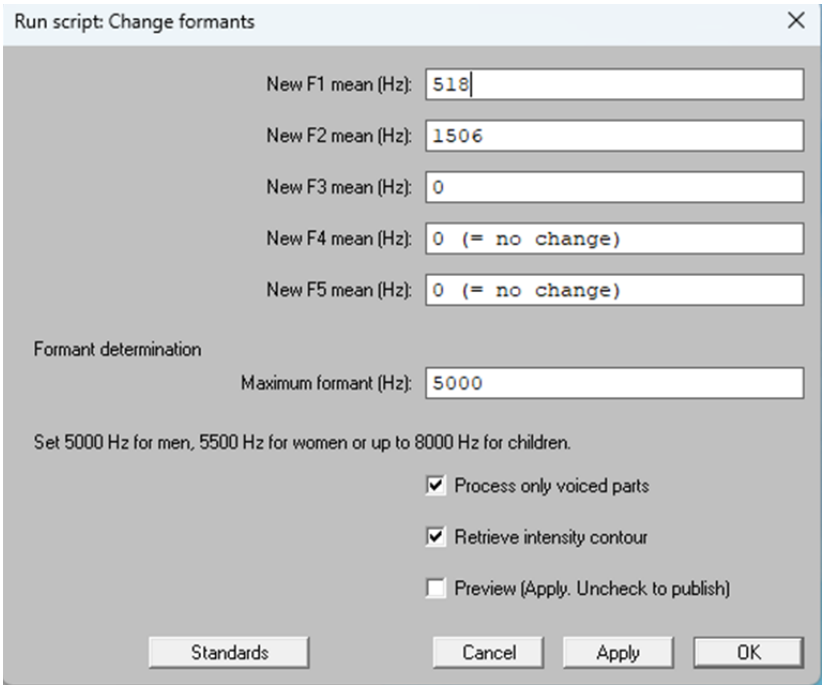

Figure 1. How **step a** would look if I'm changing a KIT vowel to be innovative.

26. The script will create a new file in Praat called something like big-p05–changeformants (or whatever word and participant you are manipulating). Let's rename this file and add –i if we changed the file to have innovative formant values or –c if we changed the file to have conservative formant values (e.g., big-p05-changeformants**-i**)

[2] I would recommend copying and pasting this table somewhere accessible, so you don't have to open this document every time to access the formant values once you get into the swing of things.

27. We want to make an innovative and conservative sound file for all words. So repeat steps 18-26 to make the other manipulation for the first word (e.g., I would end up with big-p05-changeformants-**c** if I previously made big-p05-changeformants-i).
28. Have a listen to the formants and see if they sound (a) naturally produced, (b) distinct from each other.
29. If these manipulated well, note in the Google sheet that this word manipulated at **step a** and add what Hz it was manipulated at (e.g., in the 'firstword_manipulation_step' column I would add 'a-5000' if big-p05 manipulated well here at 5000Hz).
30. Repeat **step a** with the second word (e.g., dad-p05) if this step worked.
31. If **step a** did not work well, then we move to **step b**.

b. Plug-in + voiceless

It is possible that **step a** didn't work because the vowel has unvoiced parts in it.

32. Repeat steps 20-30 above, this time unticking the Process only voiced parts box. See Figure 2 below.

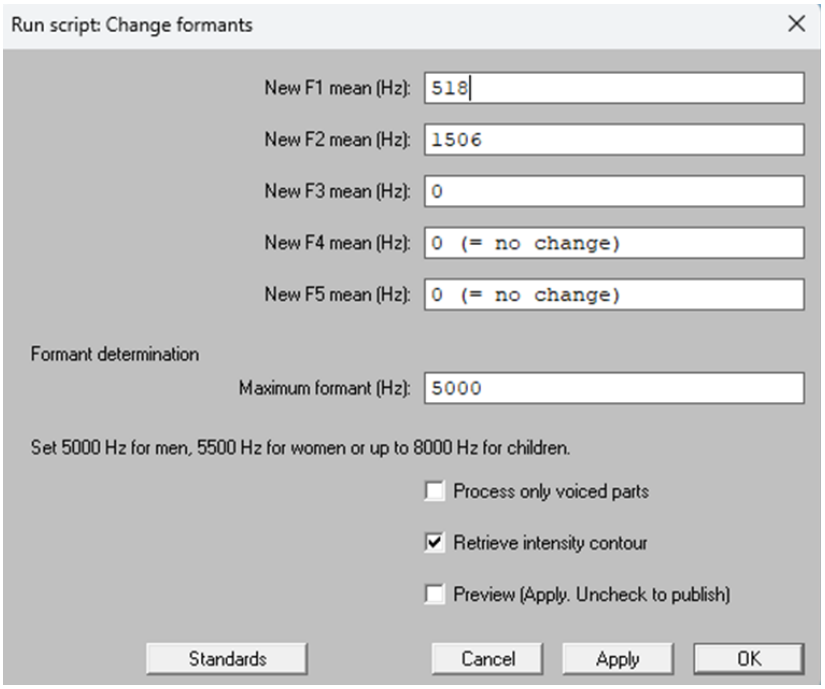

Figure 2. How **step b** would look if I'm changing a KIT vowel to be innovative and including voiceless parts of the formant.

33. If these manipulated well, note in the Google sheet that this word used **step b** and add what Hz it was manipulated at (e.g., in the 'firstword_manipulation_step' column I would add 'b-5000' if big-p05 manipulated well here at 5000Hz).

34. Repeat **step b** with the second word (e.g., dad-p05) if **step a** did not work for the second word.
35. If **step b** did not work well, then we move to **step c**.

TIP: playing around with the Hz values in **step a** and **step b** can also help too.

TIP: If these didn't work out too well, I would also try changing the duration of the vowel and trying **step a** and **step b** again before running **step c**.

c. Script

Step c uses a script that extracts the vowel before manipulating it and then adds the manipulated vowel back into the word.

36. Select the sound file and TextGrid and click View & Edit.
37. Click on the vowel phoneme based on the TextGrid tier.
38. Click File>Open editor script….
39. Select change_formant_from_TG5.
40. We want to find the line in Figure 3 to change the Hz value (if it needs changing).
41. Keep the first "yes" as "yes" for **step c**.
42. Click run.
43. A dialogue box will appear. For this box, we want to select whether we are changing the vowel to be the **innovative** or **conservative** manipulation (the checkboxes) and we enter the respective F1 and F2 values.
44. Click OK.
45. This will add a new file to the Praat window and look something like *word-participantid-i* (e.g., big-p05-i). It will also make a new folder in the participant's original folder either called mod-innovative or mod-conservative. The manipulated files are automatically saved to their corresponding folder.
46. If these manipulated well, note in the Google sheet that this word used **step c** and add what Hz it was manipulated at (e.g., in the 'firstword_manipulation_step' column I would add 'c-5000' if big-p05 manipulated well here at 5000Hz).
47. Repeat **step c** with the second word (e.g., dad-p05) if **step a** and **step b** did not work for the second word.
48. If **step c** did not work well, then we move to **step d**.

Figure 3. The line in the script that needs changing. Change only the values that the red text indicates for **step c**. Change both the red and blue values for **step e**.

d. Script + extending boundary

If **step c** did not work well, it might be because of the vowel boundary (it might also be because we only included voiced parts, we get to this in **step e**).

49. Select the sound and TextGrid files and click View & Edit.
50. Now we select the vowel manually, expanding beyond where the vowel is defined by the TextGrid to include more formants on either side of the vowel (I tend to select from where I can see tracked formant start and end).
51. Now we can run the change_formant_from_TG5 script again by following steps 38-46 above.
52. If these manipulated well, note in the Google sheet that this word used **step d** and add what Hz it was manipulated at (e.g., in the 'firstword_manipulation_step' column I would add 'd-5000' if big-p05 manipulated well here at 5000Hz).
53. Repeat **step d** with the second word (e.g., dad-p05) if **step a**, **step b,** and **step c** did not work for the second word.
54. If **step d** did not work well, then we move to **step e**.

e. Script + extending boundary + voiceless

One final step, **step e**, is to also include voiceless formants in the script.

55. Select the sound file and TextGrid and click View & Edit.
56. Now we select the vowel manually, expanding beyond where the vowel is defined by the TextGrid to include more formants on either side of the vowel (I tend to select from where I can see tracked formant start and end).
57. Open the script and find the line in Figure 3. Change the Hz value if you need **and** change the first "yes" to "no".
58. Run the script, entering the correct formant values and checking the correct boxes.

59. If these manipulated well, note in the Google sheet that this word used **step d** and add what Hz it was manipulated at (e.g., in the 'firstword_manipulation_step' column I would add 'e-5000' if big-p05 manipulated well here at 5000Hz).
60. Repeat **step e** with the second word (e.g., dad-p05) if **step a**, **step b**, **step c**, and **step d** did not work for the second word.

If none of these steps worked, we might need to change which word we selected to manipulate, remembering we must keep the two words from two different repetitions.

NOTE: The manipulations you pick must be from the same step. Don't pick an innovative one from **step b** and a conservative one from **step d**, for example. Different words can use different steps, however (e.g., big-p05 might've manipulated well at **step a** while dad-p05 might've manipulated well at **step b**).

NOTE: Every time you run the script (**step c-e**), the resulting sound file will automatically be saved in the newly made files. If you want to keep these distinct, I recommend renaming them in the files before running the script again.

TIP: Sometimes it's hard to tell if a stimulus sounds natural because of how short they are and because they are out of context. Try selecting the manipulated file with a sound file *of the other word* and click Play to see if it sounds natural in context.

NOTE: I have come across a bug in the script that sometimes shortens the vowel in the manipulated word – if that happens, email me (gia.hurring@pg.canterbury.ac.nz)

3.4 Adding silence and saving

Now that we have our four manipulations, we want to add silence to the start of the first word and to the end of the second word.

61. Begin with selecting the silence-0_3 file and one of the manipulations of the first word (e.g., big-p05-changeformants-i).
62. Click Combine>Concatenate and a new file will appear in the Praat window which is the combined sound files. Rename as *word-participantid-i/c* (e.g., big-p05-i).
63. Repeat steps 61-62 with the other manipulation of the first word (e.g., big-p05-changeformants-c → big-p05-c).
64. Next, we want to copy the silence-0_3 by selecting the file, then clicking Copy… This will create another copy of the file at the bottom of the Praat list[3].

[3] The files concatenate in the order they are loaded into Praat, thus, we need the silence to be loaded into Praat before the first word so it's added to the beginning for that word but we also need it to be loaded later than the second word so it can be added to the end of the second word – hence why we copy it!

65. Now, we want to select one of the manipulations of the second word (e.g., kid-p05-changeformants-i) and the copied silence-0_3 file and click Combine>Concatenate.
66. Rename this word as *word-participantid-i/c* (e.g., dad-p05-i).
67. Repeat step 65-66 with the other manipulation of the second word (e.g., dad-p05-changeformants-c → dad-p05-c).
68. Once we have added silences to all four files, we will save these files to the participant's silenced folder.

3.5 Concatenating all the possible combinations

69. Go to the Praat window and click Praat>Open Praat script.
70. Select the concatenate_words_final script.
71. Once the script opens, click Run.
72. A box will pop-up asking you to select the first file. Select one of the first word manipulations from the silenced folder (e.g., big-p05-i). We always want to select one of the first words first, even if they have been saved out of order
73. The pop-up box will then ask you to select the second file, so we select the other manipulation of the first word (e.g., if I have already given it big-p05-i, then this time I will select big-p05-c).
74. The pop-up box will then ask you to select the third file, so we will give it one of the second words (e.g., dad-p05-i).
75. The pop-up box will then ask you to select the fourth file, so we will give it the other manipulation of the second word (e.g., dad-p05-c). Essentially, the script is creating what is visible in Figure 4.
76. The pop-up box will now ask you a directory to save the concatenated files too. Enter the directory to the final-vowel-stimuli folder and click OK. The files have now been concatenated and saved to that folder. They have also been loaded in Praat.
77. Have a listen to the final stimuli and rate each of them of a scale of 1-5 based on 'how natural does the stimulus sound?', entering your scores into the Google sheet (1=not natural at all/entirely synthesized, 5=totally natural/like recorded speech).

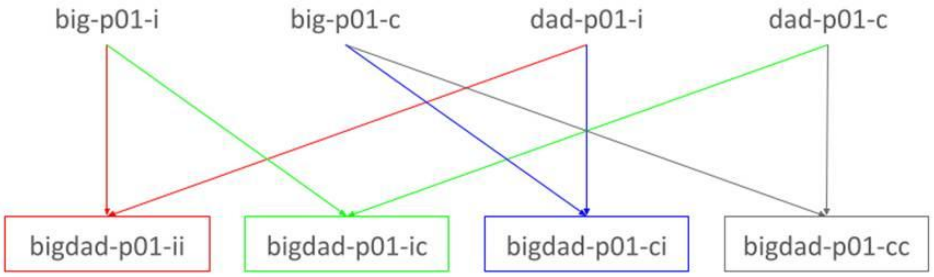

Figure 4. Visual representation of the concatenation script.

3.6 Reorganising

Once you have made the final stimuli for a word pair, we want to put all the 'interim' stimuli in a different folder to keep the workspace tidy. By 'interim' stimuli I am referring to all the saved sound files/TextGrids that were not saved in the final-vowel-stimuli folder. This will be the original recording files in the recordings folder, and the files saved in the original, silenced, and intensity folders. You may also have files in the durmod, mod_Conservative and mod_Innovative folders.

78. Go to the participant's interim folder and make a new folder with the name of the word pair you were just working on (e.g., bigdad).
79. Cut and paste all the interim files into that new folder. These interim files might include:
    - p_05-20240604-1030-15, p_05-20240604-1030-15.TextGrid (from the recordings folder)
    - big-p05, big-p05.TextGrid, kid-p05, kid-p05.TextGrid (from the original folder)
    - big-p01-durmod-008 (from the durmod folder)
    - big-p05-mod_inn, big-p05-mod_cons, kid-p05-mod_inn, kid-p05-mod_cons (from the mod_Conservative and mod_Innovative folders)
    - big-p01-i, big-p05-c, kid-p05-i, kid-p05-c (from the silenced folder)
    - big-p01-durmod-0700 (from the durmod folder, if you changed the length of the vowel)
80. Make sure all interim files have been removed from their previous folders.

Repeat Section 3 for all target stimuli for the vowels-only experiment. Instructions for the filler stimuli are provided in Section 5.

4. Vowel-and-t experiment target stimuli

Because this experiment deals with a vowel and intervocalic /t/, there are slightly different methods for the three different types of stimuli (i.e., stimuli with two /t/, stimuli with a TRAP and /t/, stimuli with TRAP vowels). Therefore, the instructions below are broken up into three sections.

4.1 Only /t/ stimuli

For these stimuli, we are making flapped /t/ manipulations and fricated /t/ manipulations. The flapped manipulations will come from flapped recordings (referred to as the flapped recordings) while the fricated manipulations will come from 's' recordings (where participants were asked to produce all intervocalic /t/ as /s/). I use the word pair 'dotty butter' as an example here.

In brief, there are six main steps:

- Finding, notetaking, and saving the best words
- Manipulate the /s/ repetitions
- Changing the intensity
- Adding silence and saving
- Concatenate all possible combinations
- Reorganising

To start

- Open Praat, click Open>read from file and load in silence-0_3.wav.
- Open the Google sheets I have shared with you. You will fill this out as you go (https://docs.google.com/spreadsheets/d/1DyLgJcfsZN2NiLOdZEZ4lQnsGKHz9tBBQV5TznUQcKM/edit?usp=sharing).

4.1.1 Finding, notetaking, and saving the best words

1. Click Open>read from file and load in a .wav file and it's corresponding .TextGrid file from a participant's recording folder.
2. Select both files in Praat and click View & Edit.
3. When dealing with stimuli that have intervocalic /t/, we need to find the corresponding 's' recording (you currently have the flapped recording loaded into Praat). Go to the covariation labbcat page (https://labbcatcorpus.canterbury.ac.nz/covariation/), sign-in, and click Search.

4. Make sure the Orthography checkbox is the only thing ticked and enter one of the words of your word pair into the Regular Expressions textbox, then hit Enter or click Search.
5. The first 20 results of that word will show (for every recording of that word and for every participant), click on *n* remaining matches (n=number) to bring up the full search list. Find the 's' recording you are looking for.
6. Click on the link to the recording you need (by clicking either of the four highlighted words) and double-check it is the right recording by listening to it or reading the instructions. You'll notice at the top of the page in big text is the name of the transcript. Copy this (ctrl+C).
7. Go back to Praat and click Open>Read from file. When it opens your folders, go to the participant's recordings folder and enter the copied transcript name into the search bar. It should bring up the original .wav and .TextGrid file for the corresponding 's' recording. Select both files. Now we should have the two recordings of the same word pair in Praat.
8. Open the second recording by clicking on the sound and TextGrid file and click View & Edit. Now you should have the first flapped recording and the second 's' recording on screen together.
9. What we need to do now is select individual words from different repetitions for each recording. Listen to all the sound files and select the best sounding words based on the criteria below:
    - Both words have similar pitches that are mostly clear/not creaky.
    - Proper pronunciation of sounds (e.g., make sure the speakers are saying /m/ and not /n/).
    - Avoid creaky sounding instances.
    - Avoid plosive 'popping' as much as possible.
    - Avoid hesitations.
    - Avoid breaths/mouth noises that are quite loud.
    - Good volume.
    - A clearly defined flap (which looks like a break in the waveform).
    - A clearly defined /s/.
10. Starting with the flapped recording, select the first word (by clicking on the word in the TextGrid tier) and click Sound>Extract selected sound (time from 0). We don't need to extract the TextGrid file for the flapped word.
11. Rename this as *word1-r* and *word2-r* where -r is for flap (e.g., if I extract the 'dotty' and 'butter' from different repetitions of the flapped recording, I will name them dotty-r and butter-r). Note which repetitions these words were taken from in the Google sheet.

12. Repeat steps 9-12 for the 's' recorded words **but** this time do extract the TextGrid tier.
13. Name the 's' files as *word1-s* and *word2-s*, where -s is for fricated (e.g., dotty-s, butter-s for both the sound file and TextGrid file).
14. Save the -r files in the participant's intensity and the -s files to the participant's original folder.

4.1.2 Manipulating the /s/ repetitions

To create the fricated stimuli, we do this by shortening the /s/ to 40ms (where it is perceivably t-like).

15. Copy the first -s recording (e.g., dotty-s) by selecting the file and clicking Copy.
16. Open the copy along with the corresponding TextGrid file.
17. Click on the /s/ phoneme in the TextGrid file and click Edit>Shorten s. This will create a new sound and TextGrid file in Praat called something like dotty-s-short_s. Have a listen to see if this sounds like a fricated /t/.
18. Repeat steps 16-18 for the second /s/ word (e.g., butter-s).
19. Save the cut /s/ words (e.g., dotty-s-short_s and butter-s-short_s) to the participant's intensity folder.

4.1.3 Changing the intensity

20. Click Praat>Open Praat script... and select the intensity_shift.praat script.
21. Run this script on all the sound files in the participant's intensity folder, setting the intensity to **65**Hz.
22. Remove the 'unintensified' sound files from the Praat window and load in the new intensity sound files.

4.1.4 Adding silence and saving

23. Select the silence-0_3 file and one of the first words (e.g., dotty-r).
24. Click Combine>Concatenate and a new file will appear in Praat which is the combined sound files. Rename as *word-participantid-r/s* (e.g., dotty-p05-r).
25. Repeat steps 24-26 with the other first word (e.g., dotty-s-short_s).
26. Next, we want to copy the silence-0_3 by selecting the file, then clicking Copy... This will create another copy of the file at the bottom of the Praat list.
27. Now, select one of the manipulations of the second word (e.g., butter-r) and the copied silence-0_3 file and click Combine>Concatenate.
28. Rename this new sound file as *word-participantid-r/s* (e.g., butter-p05-r).
29. Repeat steps 28-29 with the other second word (e.g., butter-s-short_s).

30. Once we have added silences to all the files, we will save these files to the participant's silenced folder.

4.1.5 Concatenating all possible combinations

31. Click Praat>Open Praat script and select the concatenate_words_final script.
32. Once the script opens, click Run.
33. A box will pop-up asking you to select the first file, so we select one of the first words from the silenced folder (e.g., dotty-p05-r).
34. The pop-up box will then ask you to select the second file, so we select the other first word (e.g., dotty-p05-s).
35. The pop-up box will then ask you to select the third file, so we will give it one of the second words (e.g., butter-p05-r).
36. The pop-up box will then ask you to select the fourth file, so we will give it the other manipulation of the second word, or the only file that hasn't been selected (e.g., butter-p05-s).
37. The pop-up box will now ask you a directory to save the concatenated files too. We want to save it to the final-t-stimuli folder (this is the final stimuli folder for the vowel-and-t experiment).
38. Once you have entered a directory, click OK. The files have now been concatenated and saved to that folder. They have also been loaded in Praat.
39. Have a listen to the final stimuli and rate each of them of a scale of 1-5 based on 'how natural does the stimulus sound?', entering your scores into the Google sheet (1=not natural at all/entirely synthesized, 5=totally natural/like recorded speech).

4.1.6 Reorganising

Once you have finished making the stimuli, we want to put all the 'interim' stimuli in a different folder to keep the workspace tidy. By 'interim' stimuli I am referring to all the saved sound files/TextGrids that were not saved in the final-t-stimuli folder. This will be the original recording files in the recordings folder, the files saved in the original, silenced, and intensity folders.

40. Go to the participant's interim folder make a new folder with the name of the word pair you were just working on (e.g., dottybutter).
41. Cut and paste all the interim files into that new folder .
42. Make sure all interim files have been removed from their previous folders.

Repeat Section 4.1 for all word pair stimuli that have two intervocalic /t/ and no TRAP vowels (i.e., Target TT word pairs in Table 2).

4.2 TRAP and /t/ stimuli

For these stimuli, we are making flapped and fricated manipulations for /t/ and innovative and conservative manipulations for TRAP. The flapped manipulations come from flapped recordings while the fricated manipulations will come from 's' recordings. I use the word pair 'cabin party' as an example here.

In brief, there are eight main steps:

- Finding, notetaking, and saving the best words
- Changing the vowel duration
- Split the syllables, manipulate the vowel, recombine syllables
- Cut /s/
- Run intensity script
- Add silences to start or end of intensified sound files
- Concatenate to make final stimuli
- Reorganising

To start

- Open Praat, click Open>read from file and load in silence-0_3.wav.
- Open the Google sheets I have shared with you. You will fill this out as you go (https://docs.google.com/spreadsheets/d/1DyLgJcfsZN2NiLOdZEZ4lQnsGKHz9tBBQV5TznUQcKM/edit?usp=sharing)

4.2.1 Finding, notetaking, and saving the best words

1. Click Open>read from file and load in a .wav file and it's corresponding .TextGrid file from a participant's recordings folder.
2. Select both files in Praat and click View & Edit.
3. When dealing with stimuli that have intervocalic /t/, we need to find the corresponding 's' recording (you currently have the flapped recording loaded into Praat). Go to the covariation labbcat page (https://labbcatcorpus.canterbury.ac.nz/covariation/), sign-in, and click Search.
4. Make sure the Orthography checkbox is the only thing ticked and enter one of the words of the word pairs for the recording you are trying to find into the Regular Expressions textbox, then hit Enter or click Search.
5. The first 20 results of that word will show (for every recording of that word and for every participant), click on *n* remaining matches (n=number) to bring up the full search list. Find the 's' recording you are looking for.
6. Click on the link to the recording you need (by clicking either of the four highlighted words) and double-check it is the right recording by listening to it or reading the

instructions. You'll notice at the top of the page in big text is the name of the transcript. Copy this (ctrl+C).

7. Go back to Praat and click Open>Read from file. When it opens your folders, go to the participant's recordings folder and enter the copied transcript name into the search bar. It should bring up the original .wav and .TextGrid file for the corresponding /s/ recording. Select both to load into Praat. Now we should have the two recordings of the same word pair in Praat.
8. Open the second recording by clicking on the sound and TextGrid file and click View & Edit. Now you should have the first flapped recording and the second 's' recording on screen together.
9. What we need to do now is select individual words from different repetitions. We will be selecting one flapped /t/ from the flapped recording, one /s/ word from the 's' recording, and one TRAP word from either recording. Listen to all the sound files and select the best sounding words based on the criteria below:
    - Proper pronunciation of sounds (e.g., make sure the speakers are saying /m/ and not /n/).
    - Clear formant tracking with minimal red dots missing and the formant line is mostly smooth across the vowel.
    - Visible pulses.
    - Avoid creaky sounding instances.
    - Avoid plosive 'popping' as much as possible.
    - Avoid hesitations.
    - Avoid breaths/mouth noises that are quite loud.
    - Good volume.
    - A clearly defined flap (which looks like a break in the waveform).
    - A clearly defined /s/.
10. Starting with the flapped recording, select the first word (by clicking on the word in the TextGrid tier) and click Sound>Extract selected sound (time from 0). We don't need to extract the TextGrid file for the flapped /t/ word.
11. Rename this as *word-r* where -r is for flap (e.g., party-r). Note which repetition this word was taken from in the Google sheet.
12. Repeat steps 9-11 for the 's' recorded word **but** this time do extract the TextGrid tier by selecting TextGrid>Extract selected TextGrid (time from 0).
13. Name the 's' files as *word-s*, where -s is for fricated (e.g., party-s).
14. Now we need to select one TRAP word. This word can come from either the flapped or 's' recording but it must not come from the same repetition as the -r or -s word. When the best TRAP word is identified, select the word and click Sound>Extract

selected sound (time from 0) and then TextGrid>Extract selected TextGrid (time from 0).

15. Rename the extracted TRAP files as *word-participantid* (e.g., cabin-p05). Note which repetition and recording this was taken from in the Google sheet (e.g., if I took this cabin from the second repetition in the 's' recording, I would add 2-s in the 'TRAP_repetition_selected' column).
16. Save the -r files in the participant's intensity and the TRAP and -s files to the participant's original folder.

4.2.2 Changing the vowel duration

TRAP vowels aren't usually short, but we don't want any TRAP vowels shorter than 0.09ms. These can be lengthened up to 0.25ms (we priorities long vowels over shorter ones). We can shorten TRAP vowels if they are longer than 0.4ms. This step can be skipped if the duration is good.

17. To see if the TRAP duration needs changing, select the word files (sound and TextGrid files) and click View & Edit.
18. To lengthen a vowel
    - select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Increase the vowel to the length you want it to be.
    - You'll notice a new folder has been created in your files that is called durmod this has all the different durations you've just made of that word.
19. To shorten a vowel
    - select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Decrease the vowel to the length you want it to be.
    - You'll notice a new folder has been created in your files that is called durmod this has all the different durations you've just made of that word.
20. We can change the duration of the vowel multiple times if we find one length doesn't work well in manipulation. When you find the best length note this in the Google sheet as either lengthen-(duration you lengthened it to), shortened-(time you shortened it to), or nochange (if you didn't change the vowel's duration).

4.2.3 Split the syllables, manipulate the vowel, recombine syllables

Like Section 3.4, there are steps we must go through to see which manipulation works best. However, before we do these manipulations, we need to split the disyllabic TRAP

word into its individual syllables. This is so we only manipulate the TRAP formants in the first syllable and not any vowel formants that are in the second syllable.

21. To split the syllable, select the TRAP sound and TextGrid file (e.g., cabin-p05) and click View & Edit.
22. Select the end of the first syllable by clicking on the syllable boundary line in the TextGrid (e.g., I will click on the end of the /b/ sound for the cabin-p05).
23. Click Time>Select to bring up the dialogue box which should have the time point of where the first syllable ends in both textboxes.
24. Enter **0** in the Start of selection (s) textbox and click OK.
25. Click Sound>Extracted selected sound (time from 0).
26. Extract the TextGrid of the first syllable now by clicking TextGrid>Extract selected TextGrid (time from 0).
27. Rename the extracted 'first syllable' sound files in Praat as *firstsyllable-participantid* (e.g., if I extracted 'cab' from the word 'cabin' for p_05, I would rename these files as cab-p05).
28. Now we need to extract the sound file second syllable (we do not need the TextGrid file). Select the syllable boundary again and click Time>Select.
29. In the dialogue box, enter the end time of the sound file into the End of selection (s) textbox and click OK.
30. Extract the sound file of the second syllable and rename appropriately (e.g., in-p05 for the word cabin from p_05).
31. Save the individual syllables files to the participant's original folder.
32. Now you can manipulate the TRAP vowel in the first syllable only. Follow **Section 3.4** to make the 'innovative' and 'conservative' manipulations before returning to step 33.
33. When the innovative and conservative manipulations have been successfully created, we can combine the manipulated files with the second syllable. To do this select the first manipulated syllable (e.g., cab-p05-changerformants-i) and the second unmanipulated syllable (e.g., in-p05) and click Combine>Concatenate.
34. Rename as *word-participantid-i/c* (e.g., cabin-p05-i).
35. Repeated steps 33-34 for the other TRAP manipulated sound file (e.g., cab-p05-changeforemants-c + in-p05 = cabin-p05-c).
36. Save these manipulated TRAP files to the participant's intensity folder.

4.2.4 Manipulating the /s/ repetition

To create the fricated stimuli, we do this by shortening the /s/ to 40ms (where it is perceivably t-like).

37. Copy the first -s recording (e.g., party-s) by selecting the file and clicking Copy.
38. Open the copy along with the corresponding TextGrid file.
39. Click on the /s/ phoneme in the TextGrid file and click Edit>Shorten s. This will create a new sound and TextGrid file in Praat called something like party-s-short_s. Have a listen to see if this sounds like a fricated /t/.
40. Save the cut /s/ word (e.g., party-s-short_s) to the participant's intensity folder.

4.2.5 Changing the intensity

41. Click Praat>Open Praat script... and select the intensity_shift.praat script.
42. Run this script on all the sound files in the participant's intensity folder, setting the intensity to **65**Hz.
43. Remove the 'unintensified' sound files from the Praat window and load in the new intensity sound files.

4.2.6 Adding silence and saving

44. Select the silence-0_3 file and one of the first words (e.g., cabin-p05-changeformants-i).
45. Click Combine>Concatenate and a new file will appear in Praat which is the combined sound files. Rename as *word-participantid-r/s/i/c* (e.g., cabin-p05-i).
46. Repeat steps 43-44 with the other first word (e.g., cabin-p05-changeformants-c → cabin-p05-c).
47. Next, we want to copy the silence-0_3 by selecting the file, then clicking Copy... This will create another copy of the file at the bottom of the Praat list.
48. Now, select one of the manipulations of the second word (e.g., party-r) and the copied silence-0_3 file and click Combine>Concatenate.
49. Rename this new sound file as *word-participantid-r/s/i/c* (e.g., party-p05-r).
50. Repeat steps 47-48 with the other second word (e.g., party-s-short_s → party-p05-s).
51. Once we have added silences to all the files, we will save these files to the participant's silenced folder.

4.2.7 Concatenating all possible combinations

52. Click Praat>Open Praat script and select the concatenate_words_final script.
53. Once the script opens, click Run
54. A box will pop-up asking you to select the first file, so we select one of the first words from the silenced folder (e.g., cabin-p05-i).
55. The pop-up box will then ask you to select the second file, so we select the other first word (e.g., cabin-p05-c).

56. The pop-up box will then ask you to select the third file, so we will give it one of the second words (e.g., party-p05-r).
57. The pop-up box will then ask you to select the fourth file, so we will give it the other manipulation of the second word, or the only file that hasn't been selected (e.g., party-p05-s).
58. The pop-up box will now ask you a directory to save the concatenated files too. We want to save it to the final-t-stimuli folder (this is the final stimuli folder for the vowel-and-t experiment).
59. Once you have entered a directory, click OK. The files have now been concatenated and saved to that folder. They have also been loaded in Praat.
60. Have a listen to the final stimuli and rate each of them of a scale of 1-5 based on 'how natural does the stimulus sound?', entering your scores into the Google sheet (1=not natural at all/entirely synthesized, 5=totally natural/like recorded speech).

4.2.8 Reorganising

Once you have finished making the stimuli, we want to put all the 'interim' stimuli in a different folder to keep the workspace tidy. By 'interim' stimuli I am referring to all the saved sound files/TextGrids that were not saved in the final-t-stimuli folder. This will be the original recording files in the recordings folder, the files saved in the original, silenced, and intensity folders. You may also have files in durmod, mod_Conservative and mod_Innovative folders.

61. Go to the participant's interim folder and make a new folder titled the name of the word-pair you were just working on (e.g., cabinparty).
62. Cut and paste all the interim files into that new folder
63. Make sure all interim files have been removed from their previous folders.

Repeat Section 4.2 for all word pair stimuli that have one intervocalic /t/ and one TRAP vowel (i.e., Target TRAP-T word pairs and Target T-TRAP word pairs in Table 2).

4.3 Disyllabic TRAP stimuli

For these stimuli, we are dealing with two TRAP vowels across two disyllabic words for each word pair. The steps are essentially the same as the vowels-only target stimuli in Section 3 but with the added step of splitting the TRAP word(s) before manipulating the vowel (Section 4.2.4). I use the word pair 'cabin dagger' as an example here.

In brief, there are six main steps:

- Finding, notetaking, and saving the best words
- Changing the vowel duration
- Split the syllables, manipulate the vowel, recombine syllables
- Add silences to start or end of intensified sound files
- Concatenate to make final stimuli
- Reorganising

To start

- Open Praat, click Open>read from file and load in silence-0_3.wav
- Open the Google sheets I have shared with you. You will fill this out as you go (https://docs.google.com/spreadsheets/d/1DyLgJcfsZN2NiLOdZEZ4lQnsGKHz9tBBQV5TznUQcKM/edit?usp=sharing)

4.3.1 Finding, notetaking, and saving the best words

1. Click Open>read from file and load in a .wav file and it's corresponding .TextGrid file from a participant's recordings folder.
2. Select both files in Praat and click View & Edit.
3. If your formant tracking is turned off, click Formants and check Show formants.
4. If your pulse tracking is turned off, click Pulses and check Show Pulses.
5. Have a look and listen to each word pair utterance up close. We want to pick the best sounding words **from different repetitions** (i.e., the first and second word cannot come from the same repetition). Follow this guide to decide which repetition of the word should be picked:
    - Proper pronunciation of sounds there (e.g., some instances might be rhotic (which we don't want), people might have said 'm' instead of 'n').
    - Clear formant tracking with minimal red dots missing and the formant line is mostly smooth across the vowel.
    - Visible pulses.
    - Avoid creaky sounding instances.
    - Avoid short TRAPs (see Table 3).
    - Avoid plosive 'popping' as much as possible.

- Avoid hesitations.
- Avoid breaths/mouth noises that are quite loud.
- Good volume.
- It's most likely that the second and third utterance will be the best.

6. When you find the best first word, select the full word (by clicking the whole word in the tier), and click Sound>Extract selected sound (time from 0) then click TextGrid>Extract selected TextGrid (time from 0).
7. Repeat steps 5-6 for the second word.
8. Write in the Google sheet which repetition (1-4) each word came from in the relevant columns.
9. You'll notice four new files in Praat, these are the words you extracted (in order) so we should rename them appropriately. Select the first file and click Rename… Rename these files as *word-participantid* (e.g., cabin-p05 for both the sound and TextGrid file, dagger-p05 for both the sound and TextGrid file).
10. Save these files to the participant's original folder. To do this, select the sound file and click Save>Save as WAV file… Repeat with the second word. For the TextGrid files, select the TextGrid file and click Save>Save as text file… Repeat with the second word.
11. Remove these from Praat (avoid removing the silence-0_3 file) by selecting all four files and clicking Remove…

4.3.2 Changing the vowel duration

TRAP vowels aren't usually short, but we don't want any TRAP vowels shorter than 0.09ms. These can be lengthened up to 0.25ms (we priorities long vowels over shorter ones). We can shorten TRAP vowels if they are longer than 0.4ms. This step can be skipped if the duration is good.

12. To see if the TRAP duration needs changing, select the word files (sound and TextGrid files) and click View & Edit.
13. <u>To lengthen a vowel</u>
    - select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Increase the vowel to the length you want it to be.
    - You'll notice a new folder has been created in your files that is called durmod this has all the different durations you've just made of that word.
14. <u>To shorten a vowel</u>

- select the vowel portion of the word (by clicking on the vowel in the TextGrid) and click Edit>Change vowel duration. Decrease the vowel to the length you want it to be.
- You'll notice a new folder has been created in your files that is called durmod this has all the different durations you've just made of that word.

15. We can change the duration of the vowel multiple times if we find one length doesn't work well in manipulation. When you find the best length note this in the Google sheet as either lengthen-(duration you lengthened it to), shortened-(time you shortened it to), or nochange (if you didn't change the vowel's duration).

4.3.4 Split the syllables, manipulate the vowel, recombine syllables

Like Section 3.4, there are steps we must go through to see which manipulation works best. However, before we do these manipulations, we need to split the disyllabic TRAP word into its individual syllables. This is so we only manipulate the TRAP formants in the first syllable and not any vowel formants that are in the second syllable.

16. To split the syllable, select the TRAP sound and TextGrid file (e.g., cabin-p05) and click View & Edit.
17. Select the end of the first syllable by clicking on the syllable boundary line in the TextGrid (e.g., I will click on the end of the /b/ sound for the cabin-p05).
18. Click Time>Select to bring up the dialogue box which should have the time point of where the first syllable ends in both textboxes.
19. Enter **0** in the Start of selection (s) textbox and click OK.
20. Click Sound>Extracted selected sound (time from 0).
21. Extract the TextGrid of the first syllable now by clicking TextGrid>Extract selected TextGrid (time from 0).
22. Rename the extracted 'first syllable' sound files in Praat as *firstsyllable-participantid* (e.g., if I extracted 'cab' from the word 'cabin' for p_05, I would rename these files as cab-p05).
23. Now we need to extract the sound file second syllable (we do not need the TextGrid file). Select the syllable boundary again and click Time>Select.
24. In the dialogue box, enter the end time of the sound file into the End of selection (s) textbox and click OK.
25. Extract the sound file of the second syllable and rename appropriately (e.g., in-p05 for the word cabin from p_05).
26. Save the individual syllables files to the participant's original folder.
27. Now you can manipulate the TRAP vowel in the first syllable only. Follow **Section 3.4** to make the 'innovative' and 'conservative' manipulations before returning to step 28.

28. When the innovative and conservative manipulations have been successfully created, we can combine the manipulated files with the second syllable. To do this select the first manipulated syllable (e.g., cab-p05-changerformants-i) and the second unmanipulated syllable (e.g., in-p05) and click Combine>Concatenate.
29. Rename as *word-participantid-i/c* (e.g., cabin-p05-i).
30. Repeated steps 16-29 for the other TRAP manipulated sound file (e.g., cab-p05-changeforemants-c + in-p05 = cabin-p05-c).
31. Repeat steps 16-29 for the other TRAP word (e.g., dagger-p05).
32. Save all four manipulated TRAP files to the participant's intensity folder.

4.3.4 Adding silence and saving

33. Select the silence-0_3 file and one of the first words (e.g., cabin-p05-changeformants-i).
34. Click Combine>Concatenate and a new file will appear in Praat which is the combined sound files. Rename as *word-participantid-i/c* (e.g., cabin-p05-i).
35. Repeat steps 33-34 with the other first word (e.g., cabin-p05-changeformants-c → cabin-p05-c).
36. Next, we want to copy the silence-0_3 by selecting the file, then clicking Copy... This will create another copy of the file at the bottom of the Praat list.
37. Now, select one of the manipulations of the second word (e.g., dagger-p05-changeformants-i) and the copied silence-0_3 file and click Combine>Concatenate.
38. Rename this new sound file as *word-participantid-i/c* (e.g., dagger-p05-i).
39. Repeat steps 37-38 with the other second word (e.g., dagger-p05-changeformants-c → dagger-p05-c).
40. Once we have added silences to all the files, we will save these files to the participant's silenced folder.

4.3.5 Concatenating all possible combinations

41. Click Praat>Open Praat script and select the concatenate_words_final script.
42. Once the script opens, click Run.
43. A box will pop-up asking you to select the first file, so we select one of the first words from the silenced folder (e.g., cabin-p05-i).
44. The pop-up box will then ask you to select the second file, so we select the other first word (e.g., cabin-p05-c).
45. The pop-up box will then ask you to select the third file, so we will give it one of the second words (e.g., dagger-p05-i).

46. The pop-up box will then ask you to select the fourth file, so we will give it the other manipulation of the second word, or the only file that hasn't been selected (e.g., dagger-p05-c).
47. The pop-up box will now ask you a directory to save the concatenated files too. We want to save it to the final-t-stimuli folder (this is the final stimuli folder for the vowel-and-t experiment).
48. Once you have entered a directory, click OK. The files have now been concatenated and saved to that folder. They have also been loaded in Praat.
49. Have a listen to the final stimuli and rate each of them of a scale of 1-5 based on 'how natural does the stimulus sound?', entering your scores into the Google sheet (1=not natural at all/entirely synthesized, 5=totally natural/like recorded speech).

4.3.6 Reorganising

Once you have finished making the stimuli, we want to put all the 'interim' stimuli in a different folder to keep the workspace tidy. By 'interim' stimuli I am referring to all the saved sound files/TextGrids that were not saved in the final-t-stimuli folder. This will be the original recording files in the recordings folder, the files saved in the original, silenced, and intensity folders. You may also have files in durmod, mod_Conservative and mod_Innovative folders.

50. Go to the participant's interim folder make a new folder titled the name of the word-pair you were just working on (e.g., cabindagger).
51. Cut and paste all the interim files into that new folder.
52. Make sure all interim files have been removed from their previous folders.

Repeat Section 4.3 for all word pair stimuli that have two TRAP vowels and no intervocalic /t/ (i.e., Target TRAP-TRAP word pairs in Table 2).

5. Filler stimuli

These instructions will take you through what to do when you load in filler stimuli. This is relevant to both the vowels-only and vowel-and-t experiment. I use the word pair 'fourth cup' as an example here.

In brief, there are three main steps:

- Find and select the best word pair
- Adding silence and saving
- Reorganising

To start

- Open Praat, click Open>read from file and load in silence-0_3.wav
- Open the Google sheets I have shared with you. You will fill this out as you go (https://docs.google.com/spreadsheets/d/1DyLgJcfsZN2NiLOdZEZ4lQnsGKHz9tBBQV5TznUQcKM/edit?usp=sharing)

5.1 Find and select the best word pair

1. Click Open>read from file and load in a .wav file and it's corresponding .TextGrid file from a participant's recordings folder.
2. Select both files in Praat and click View & Edit.
3. Find which word pair sounds the best, following this guide:
    - Proper pronunciation of sounds (e.g., some instances might be rhotic (which we don't want), people might have said 'm' instead of 'n').
    - Avoid creaky sounding instances.
    - Avoid plosive 'popping' as much as possible.
    - Avoid hesitations.
    - Avoid breaths/mouth noises that are quite loud.
    - Clear voice/pitch – typically people's last utterance goes quieter and less clear, it's unlikely that the fourth utterance will be the best.
4. Once you find the best word pair (they must come from the **same repetition**), select the entire word pair (based on the word boundaries in the TextGrid tier) and click Sound>Extract select sound (from 0). We do need to extract the TextGrid.
5. This will create a new file in Praat, rename the extracted sound as *wordpair* (e.g., fourthcup).
6. Write in the Google sheet which repetition you took the word pair from.

5.2 Adding silences and saving

7. Once we have renamed the file, we can add silence to the beginning and end of the file. Copy the silence-0_3 by selecting the file, then clicking Copy… This will create another copy of the file at the bottom of the Praat list.
8. Now, we want to select the original uncopied silence-0_3, the word pair (e.g., fourthcup), and the copied silence-0_3 in this order and click Combine>Concatenate.
9. This will create a new sound file that has silence at the beginning and end of the filler stimuli. Rename this new sound file as *wordpair-participantid* (e.g., fourthcup-p05).
10. Select the final stimuli and click Save>Save as WAV file….
11. Save the file in either the final-vowel-stimuli folder if they are a monosyllabic word pair or save in the final-t-stimuli if they are a disyllabic word pair.

5.3 Reorganising

Once you have finished making the stimuli, we want to put all the 'interim' stimuli in a different folder to keep the workspace tidy. By 'interim' stimuli I am referring to all the saved sound files/TextGrids that were not saved in the final-vowel-stimuli or final-t-stimuli folder. This includes files in the participant's recordings folder and any additional files you saved.

12. Go to the participant's interim folder and create a new folder titled the name of the word pair you were just working on (e.g., fourthcup).
13. Cut and paste all the original files into that new folder.
14. Make sure all interim files have been removed from their previous folders.

Repeat Section 5 for all filler stimuli.