Guided Research Seminar: Flexibility and adaptation in speech perception

Semester 2, Spring 2025

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Table of contents

Seminar overview

This page is the course overview for the seminar. If you prefer a pdf, that can be accessed here. We will have occasional weekly activities to complete at home, which will appear in the tabs at left left.

This seminar will survey research on how adult listeners adapt perceptual categories in speech perception. The goal is to equip students with a foundational knowledge of relevant speech perception methods, their use in understanding perceptual flexibility, and what flexibility in speech perception tells us about linguistic representations and the way that listeners process speech. The common thread across topics and phenomena will be the finding that speech perception is a dynamic process, and that listeners actively track and learn about speech as they experience it. This seminar presupposes some knowledge of phonetics and phonology: LEL2A + 2B or MSc Introduction to Phonetics and Phonology, or equivalent.

- **Time** Thursdays 14:10-15:00
- **Place** 9.01 40GS
- Meetings can be booked with me here. If the availability there doesn't work for you, get in touch and we can set up another time.

Seminar Format

Some more details and format for the discussion will be introduced at our first meeting, however, broadly, in each Seminar we will discuss a reading, revolving around several questions.

- What is the big picture question about speech perception? What are the relevant theories/models?
- What are the methods like and how do they address the big picture question?
- What connections to your own research interests do you see in the paper?

Before each Thursday meeting you can **submit a brief reflection on the paper here**. The goal of these is just to help put your thoughts down, and also for me to see if there are questions about each paper before we meet, which I can hopefully address in the seminar.

Assessment

Assignment 1: Due 17 March

Assignment 1 will be a literature review of a phenomenon of your choice, with the goal of orienting towards research questions that can be part of Assignment 2. The Seminar is focused around four core phenomena, one of which can be selected for this assignment; **but another one can be chosen if discussed with me.**

More details will be discussed Week 6.

- Distributional learning for cues
- Cue weighting and cue shifting
- Selective adaptation
- Lexically-guided perceptual re-tuning

Requirements

- Honours and 10cr MSc students: 1500 words (30% of final mark)
- 20cr MSc students: 1500 words (20% of final mark)

Assignment 2: Due 24 April

A research project proposal. This can build directly on a previous study, or be anything of interest to you. It would be easier to make this close to, or the same as, the topic you did a literature review for in Assignment 1, however this is not required. More details will be discussed Week 7.

Requirements

- Honours and 10cr MSc students: 2500 words (70% of final mark)
- 20cr MSc students: 4000 words (80% of final mark)

Timetable

Week	Topic	Reading	Other activity
Jan 23	Methods/basics	Schertz and Clare (2020)	Perceptual categorisation experiment
Jan 30	Distributional learning	Theodore, Monto, and Graham (2020)	
Feb 6	Cue weighting/shifting I	Idemaru and Holt (2011)	Cue shifting experiment
Feb 13	Cue weighting/shifting II	Lehet and Holt (2017) OR Liu and Holt (2015)	
Feb 20	Flexible learning week	———	———
Feb 27	Selective adaptation I	Ades (1974)	Assignment 1 discussion
Mar 6	Selective adaptation II	Samuel (2020)	Selective adaptation experiment
Mar 13	Lexically-guided perceptual retuning I	Norris, McQueen, and Cutler (2003)	
Mar 20	Lexically-guided perceptual retuning II	Caudrelier et al. (2023)	
Mar 27	Assignment ideas and discussion		
Apr 3	Assignment ideas and discussion		

Readings

Below, the readings from the course are complemented by others which are organised by topic - you can consider that these a possible starting point for your assignments. There are also some sort of random included readings. Hover over the reading to see the reference, or find it in the full reference list below.

General: cues and methods

Schertz and Clare (2020)

Holt and Lotto (2010)

Apfelbaum et al. (2022)

Distributional learning

Clayards et al. (2008)

Kleinschmidt and Jaeger (2015)

Theodore, Monto, and Graham (2020)

Selective Adaptation

Ades (1974)

Dias, Cook, and Rosenblum (2016)

Kleinschmidt and Jaeger (2016)

Mitterer, Reinisch, and McQueen (2018)

Samuel (1986)

Samuel (2020)

Sawusch (1977)

Sussman (1993)

Cue weighting and shifting - "dimension-based statistical learning"

Idemaru and Holt (2011)

Idemaru and Holt (2020)

Jasmin et al. (2023)

Lehet and Holt (2017)

Liu and Holt (2015)

Severijnen et al. (2023)

Lexically-guided perceptual retuning

Caudrelier et al. (2023)

Charoy and Samuel (2023)

Cummings and Theodore (2022)

Kraljic and Samuel (2006)

McQueen, Cutler, and Norris (2006)

Norris, McQueen, and Cutler (2003)

Tzeng, Nygaard, and Theodore (2021)

Other recommended readings

These didn't fit into the above categories really, check them out if they are on a topic of interest.

Bushong and Jaeger (2019)

Colby et al. (2019)

D'Onofrio (2015)

Gonzales, Byers-Heinlein, and Lotto (2019)

Luo et al. (2024)

Niedzielski (1999)

Xie, Jaeger, and Kurumada (2023)

Full reference list

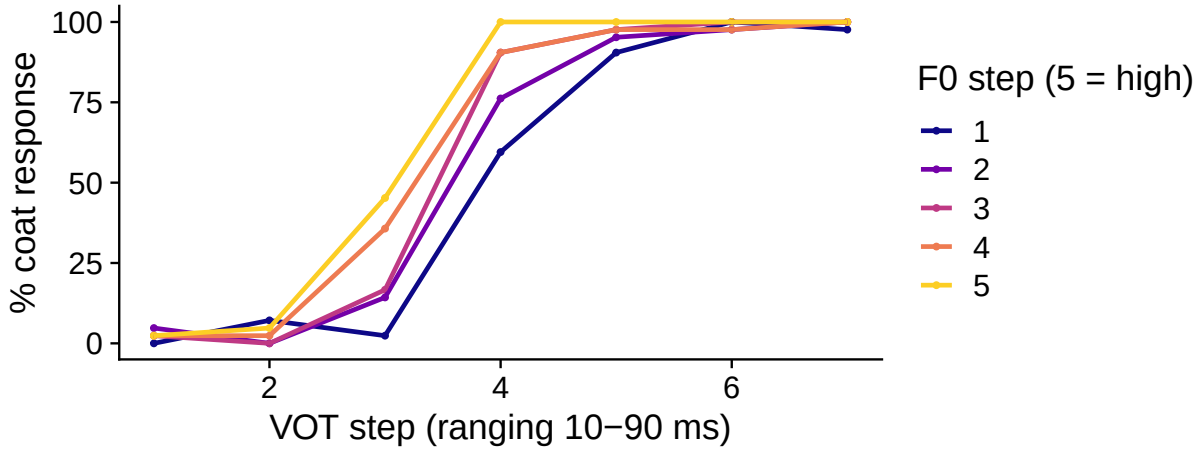
(appears at the very end of the PDF document).

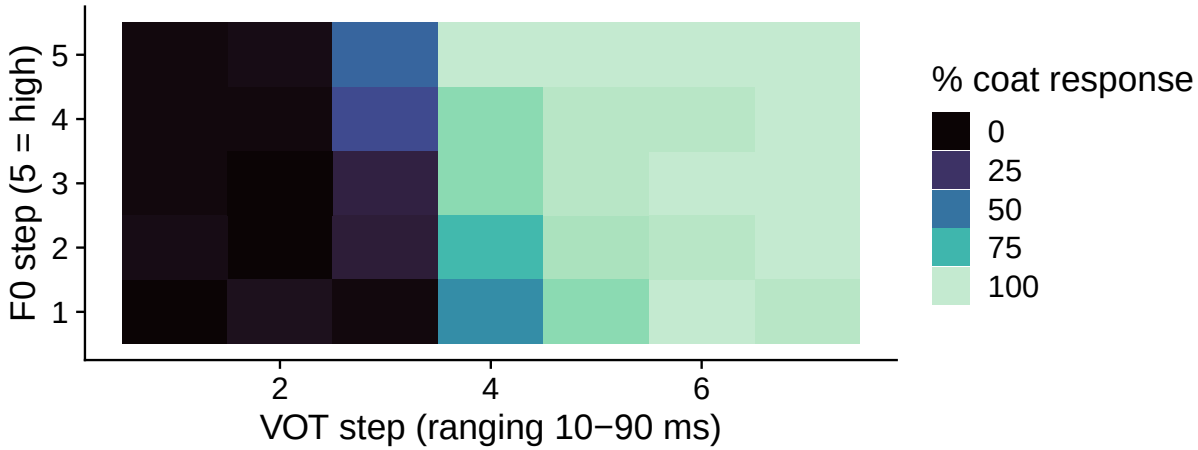
1 Perceptual categorisation experiment

You can find the experiment here.

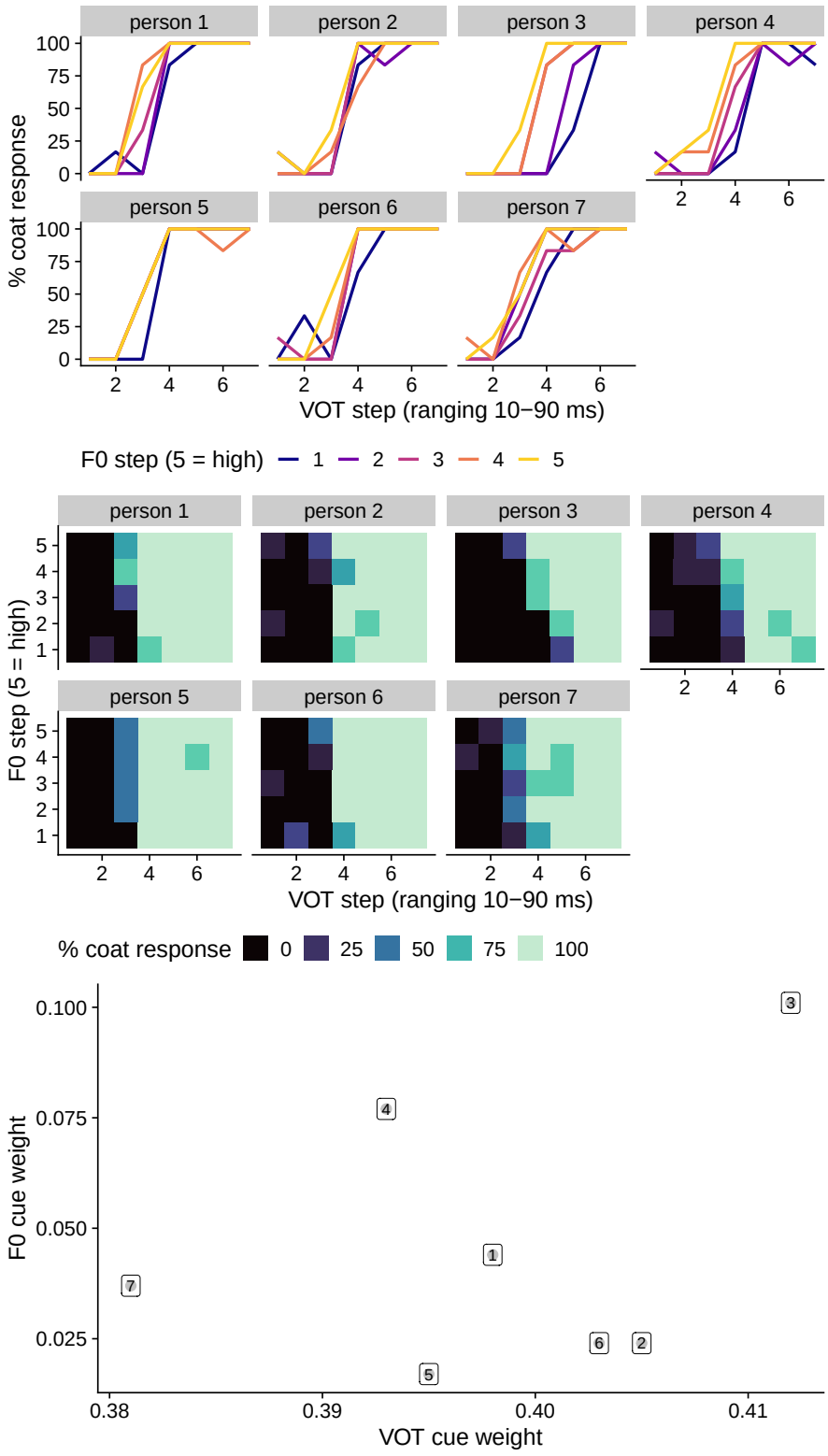
1.0.1 Results

Here are the overall categorisation functions, shown in two different ways below.





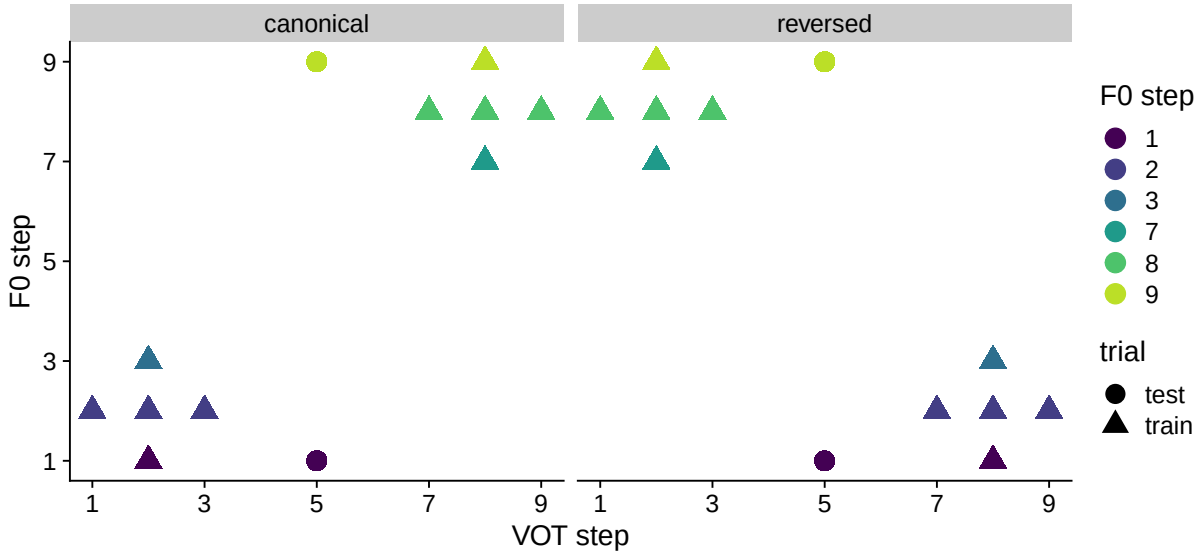
And here are the individual-level ones.


person 1
person 2
person 3
person 4
person 5
person 6
person 7
% coat response
VOT step (ranging 10−90 ms)
F0 step (5 = high) 1 2 3 4 5
F0 step (5 = high)
% coat response 0 25 50 75 100
F0 cue weight
VOT cue weight

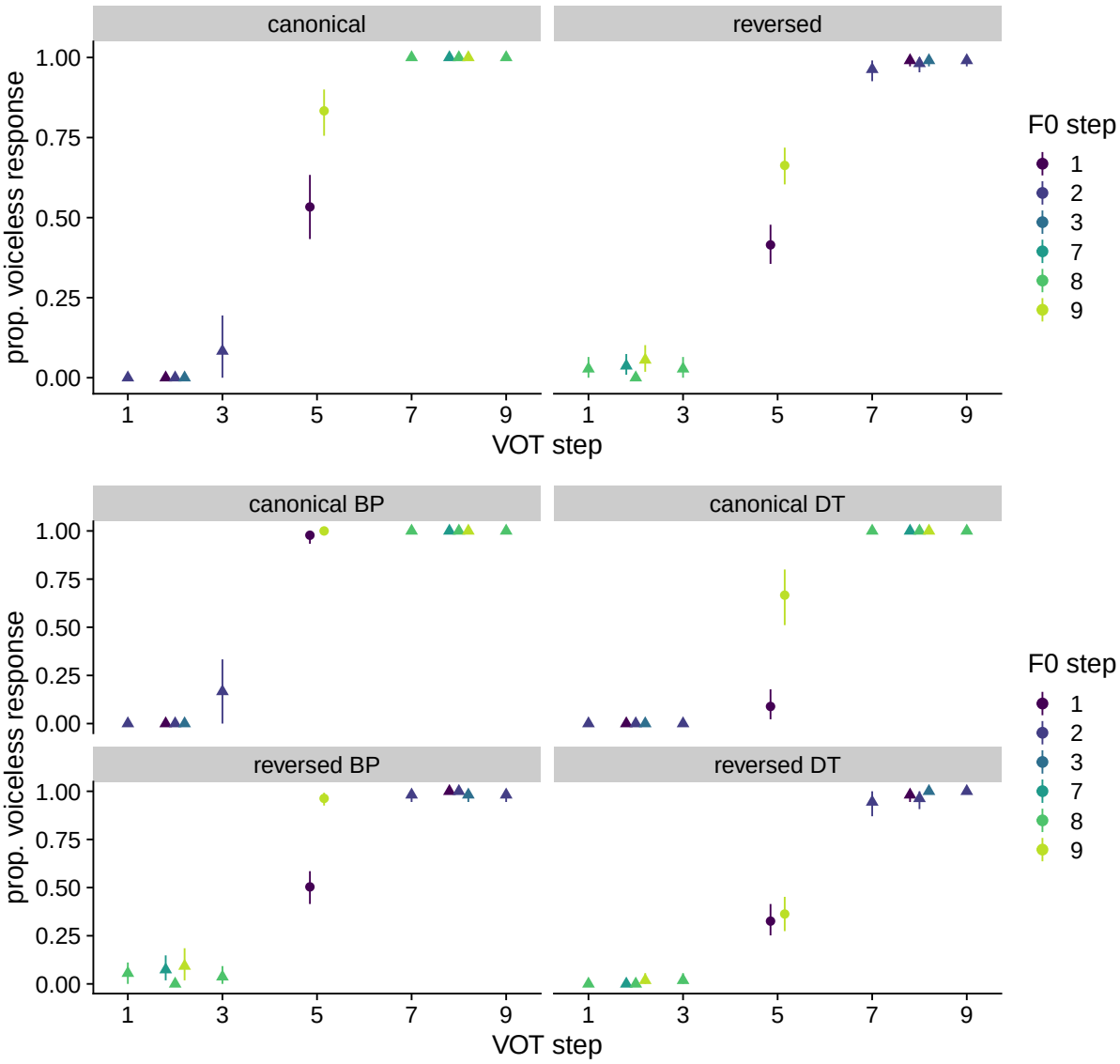
2 Cue shifting experiment

You can find the experiment here.

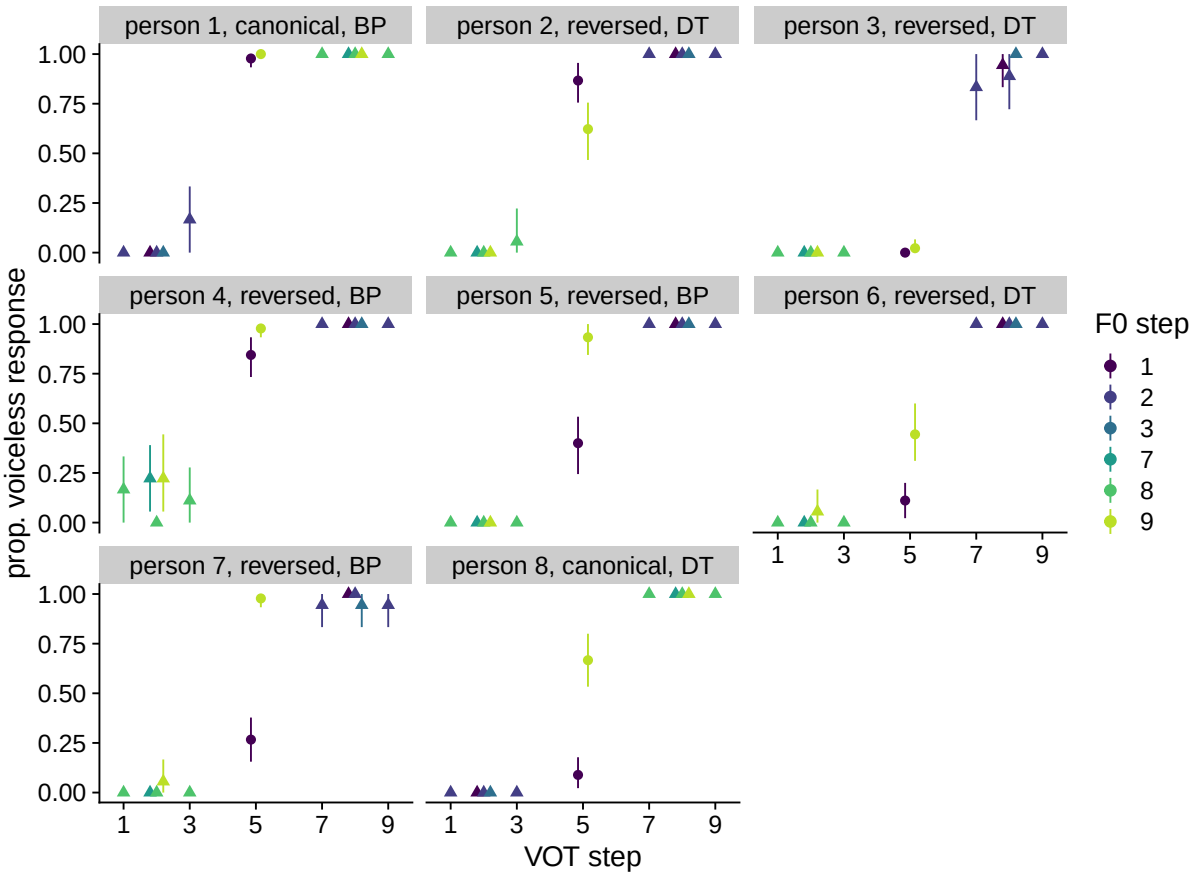
Here are the cue distributions used in the two conditions.



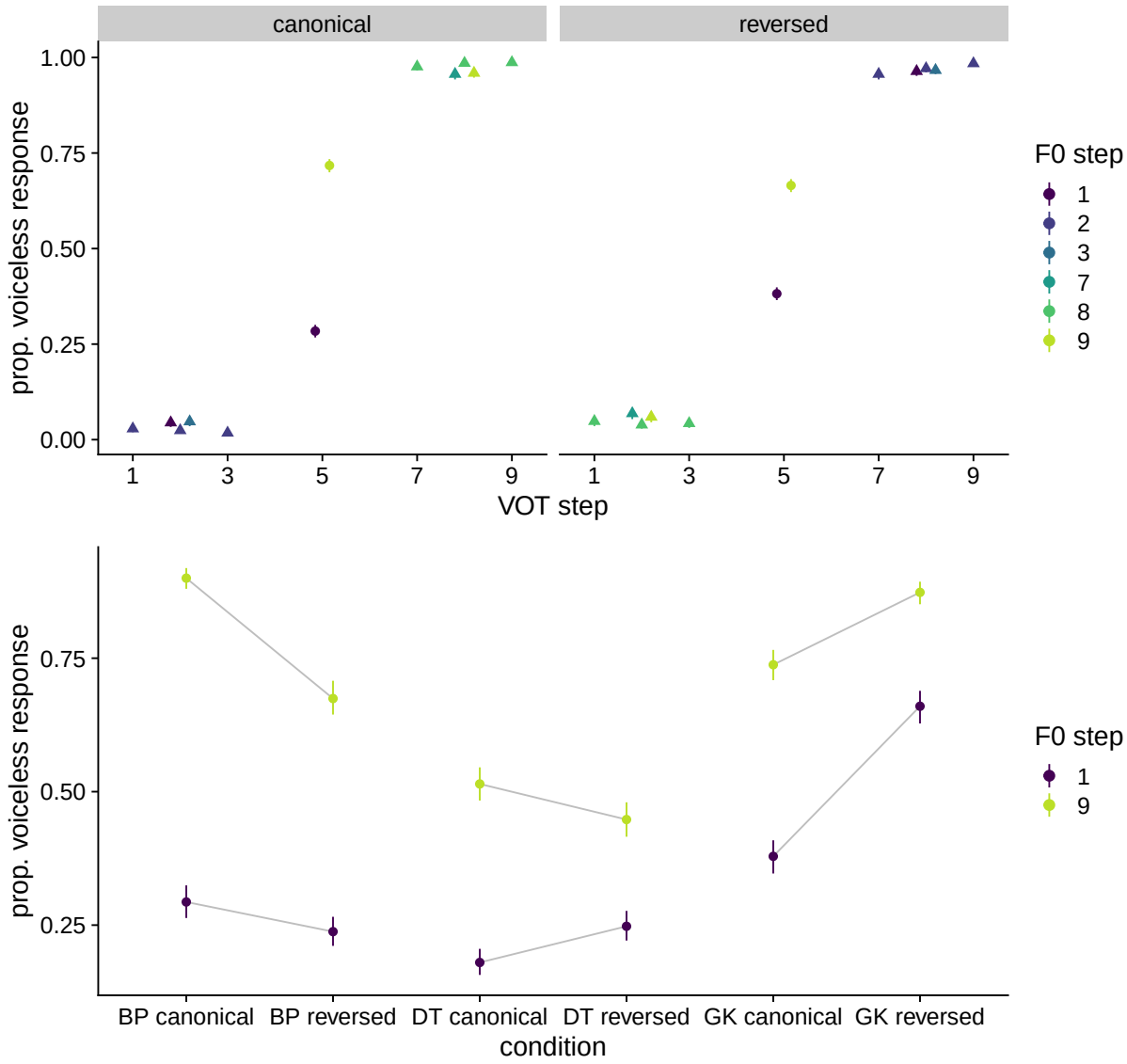
And here are the results, first pooled by place of articulation and then split by it. Note that the canonical BP person did not find the stimuli at VOT step 5 to be ambiguous - this can be a major challenge for this type of research!



And here are the results split out by individuals. It ended up being unbalanced with only two canonical people . Note that person 2 fully reversed the F0 effect.



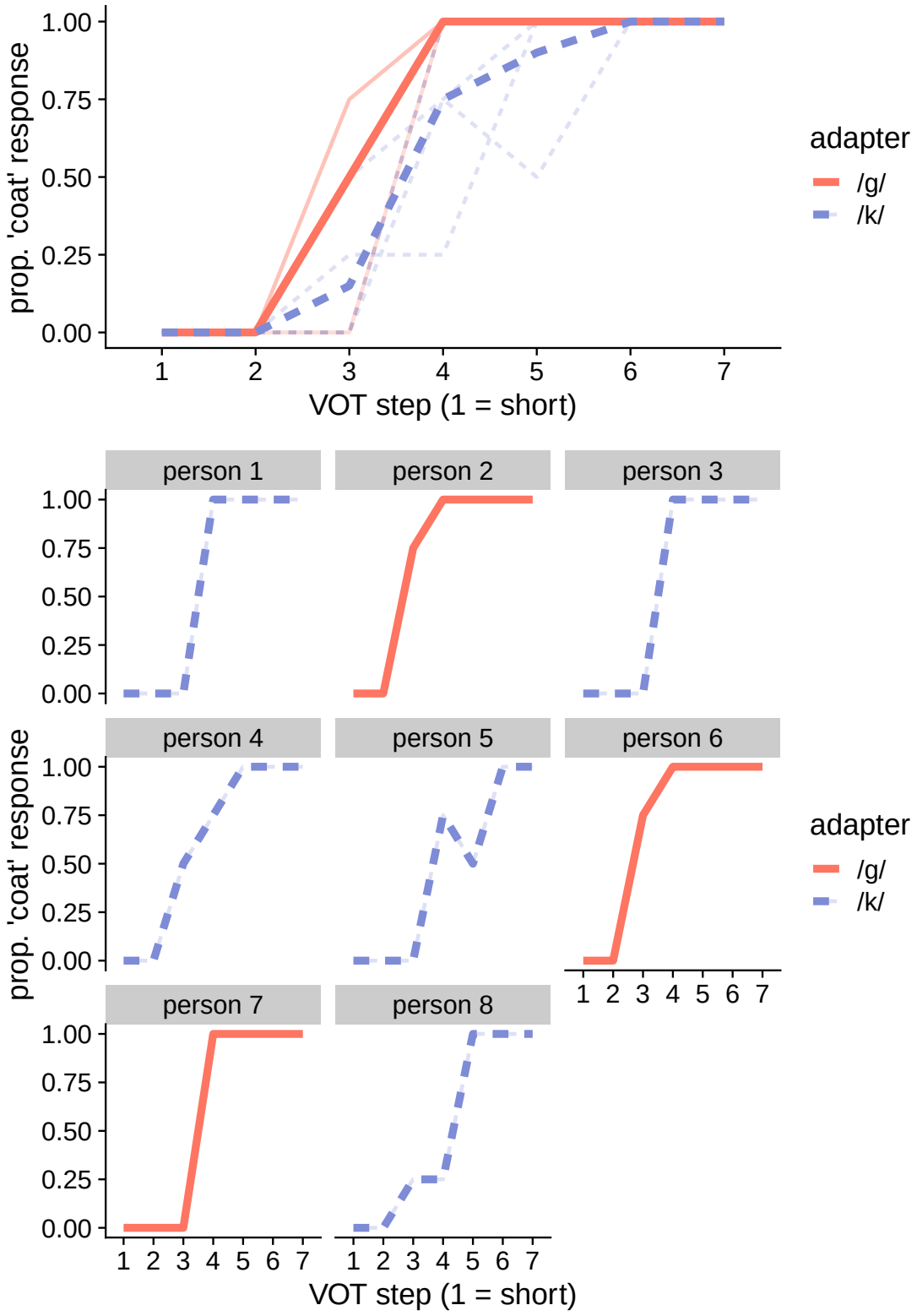
Finally, in case you are curious, here are the results from a study that I ran which had a larger group of participants (20 people in each place and each distribution condition). In the second plot below, just the trials at VOT step 5 are plotted.


canonical
reversed
prop. voiceless response
1.00
0.75
0.50
0.25
0.00
1
3
5
7
9
VOT step
F0 step
1
2
3
7
8
9
prop. voiceless response
0.75
0.50
0.25
BP canonical
BP reversed
DT canonical
DT reversed
GK canonical
GK reversed
condition
F0 step
1
9

3 Selective adaptation experiment

You can find the experiment here.

Note that the adapter condition, shown at right indicates whether ‘goat’ or ‘coat’ was heard as an adapter prior to the test trials.


prop. 'coat' response
1.00
0.75
0.50
0.25
0.00
1
2
3
4
5
6
7
VOT step (1 = short)
adapter
/g/
/k/
person 1
person 2
person 3
person 4
person 5
person 6
person 7
person 8

Ades, Anthony E. 1974. "How Phonetic Is Selective Adaptation? Experiments on Syllable Position and Vowel Environment." *Perception & Psychophysics* 16 (1): 61–66.

Apfelbaum, Keith S, Ethan Kutlu, Bob McMurray, and Efthymia C Kapnoula. 2022. "Don't Force It! Gradient Speech Categorization Calls for Continuous Categorization Tasks." *The Journal of the Acoustical Society of America* 152 (6): 3728–45.

Bushong, Wednesday, and T Florian Jaeger. 2019. "Dynamic Re-Weighting of Acoustic and Contextual Cues in Spoken Word Recognition." *The Journal of the Acoustical Society of America* 146 (2): EL135–40.

Caudrelier, Tiphaine, Clara D Martin, Arthur G Samuel, Marie-Michèle Beausoleil, Mark Tiede, and Lucie Ménard. 2023. "Lexically-Guided Phonetic Recalibration Transfers Across Languages in French-English Bilinguals." *Proceedings of the International Congress of Phonetics Sciences*, 2911–15.

Charoy, Jeanne, and Arthur G Samuel. 2023. "Bad Maps May Not Always Get You Lost: Lexically Driven Perceptual Recalibration for Substituted Phonemes." *Attention, Perception, & Psychophysics*, 1–22.

Clayards, Meghan, Michael K Tanenhaus, Richard N Aslin, and Robert A Jacobs. 2008. "Perception of Speech Reflects Optimal Use of Probabilistic Speech Cues." *Cognition* 108 (3): 804–9.

Colby, Sarah, Douglas M Shiller, Meghan Clayards, and Shari Baum. 2019. "Different Responses to Altered Auditory Feedback in Younger and Older Adults Reflect Differences in Lexical Bias." *Journal of Speech, Language, and Hearing Research* 62 (4S): 1144–51.

Cummings, Shawn N, and Rachel M Theodore. 2022. "Perceptual Learning of Multiple Talkers: Determinants, Characteristics, and Limitations." *Attention, Perception, & Psychophysics* 84 (7): 2335–59.

D'Onofrio, Annette. 2015. "Perceiving Personae: Effects of Social Information on Perceptions of TRAP-Backing." *University of Pennsylvania Working Papers in Linguistics* 21 (2): 5.

Dias, James W, Theresa C Cook, and Lawrence D Rosenblum. 2016. "Influences of Selective Adaptation on Perception of Audiovisual Speech." *Journal of Phonetics* 56: 75–84.

Gonzales, Kalim, Krista Byers-Heinlein, and Andrew J Lotto. 2019. "How Bilinguals Perceive Speech Depends on Which Language They Think They're Hearing." *Cognition* 182: 318–30.

Holt, Lori L., and Andrew J. Lotto. 2010. "Speech Perception as Categorization." *Attention, Perception, & Psychophysics* 72 (5): 1218–27. https://doi.org/10.3758/APP.72.5.1218.

Idemaru, Kaori, and Lori L Holt. 2011. "Word Recognition Reflects Dimension-Based Statistical Learning." *Journal of Experimental Psychology: Human Perception and Performance* 37 (6): 1939.

———. 2020. "Generalization of Dimension-Based Statistical Learning." *Attention, Perception, & Psychophysics* 82: 1744–62.

Jasmin, Kyle, Adam Tierney, Chisom Obasih, and Lori Holt. 2023. "Short-Term Perceptual Reweighting in Suprasegmental Categorization." *Psychonomic Bulletin & Review* 30 (1): 373–82.

Kleinschmidt, Dave F, and T Florian Jaeger. 2015. "Robust Speech Perception: Recognize the Familiar, Generalize to the Similar, and Adapt to the Novel." *Psychological Review* 122

(2): 148.
———. 2016. “Re-Examining Selective Adaptation: Fatiguing Feature Detectors, or Distributional Learning?” *Psychonomic Bulletin & Review* 23: 678–91.
Kraljic, Tanya, and Arthur G Samuel. 2006. “Generalization in Perceptual Learning for Speech.” *Psychonomic Bulletin & Review* 13 (2): 262–68.
Lehet, Matthew, and Lori L Holt. 2017. “Dimension-Based Statistical Learning Affects Both Speech Perception and Production.” *Cognitive Science* 41: 885–912.
Liu, Ran, and Lori L Holt. 2015. “Dimension-Based Statistical Learning of Vowels.” *Journal of Experimental Psychology: Human Perception and Performance* 41 (6): 1783.
Luo, Yingyi, Holger Mitterer, Xiaolin Zhou, and Yiya Chen. 2024. “Flexibility and Stability in Lexical Tone Recalibration: Evidence from Tone Perceptual Learning.” *Language and Speech*, 00238309241291536.
McQueen, James M, Anne Cutler, and Dennis Norris. 2006. “Phonological Abstraction in the Mental Lexicon.” *Cognitive Science* 30 (6): 1113–26.
Mitterer, Holger, Eva Reinisch, and James M McQueen. 2018. “Allophones, Not Phonemes in Spoken-Word Recognition.” *Journal of Memory and Language* 98: 77–92.
Niedzielski, Nancy. 1999. “The Effect of Social Information on the Perception of Sociolinguistic Variables.” *Journal of Language and Social Psychology* 18 (1): 62–85.
Norris, Dennis, James M McQueen, and Anne Cutler. 2003. “Perceptual Learning in Speech.” *Cognitive Psychology* 47 (2): 204–38.
Samuel, Arthur G. 1986. “Red Herring Detectors and Speech Perception: In Defense of Selective Adaptation.” *Cognitive Psychology* 18 (4): 452–99.
———. 2020. “Psycholinguists Should Resist the Allure of Linguistic Units as Perceptual Units.” *Journal of Memory and Language* 111: 104070.
Sawusch, James R. 1977. “Processing of Place Information in Stop Consonants.” *Perception & Psychophysics* 22 (5): 417–26.
Schertz, Jessamyn, and Emily J Clare. 2020. “Phonetic Cue Weighting in Perception and Production.” *Wiley Interdisciplinary Reviews: Cognitive Science* 11 (2): e1521.
Severijnen, Giulio GA, Giuseppe Di Dona, Hans Rutger Bosker, and James M McQueen. 2023. “Tracking Talker-Specific Cues to Lexical Stress: Evidence from Perceptual Learning.” *Journal of Experimental Psychology: Human Perception and Performance* 49 (4): 549.
Sussman, Joan E. 1993. “Auditory Processing in Children’s Speech Perception: Results of Selective Adaptation and Discrimination Tasks.” *Journal of Speech, Language, and Hearing Research* 36 (2): 380–95.
Theodore, Rachel M, Nicholas R Monto, and Stephen Graham. 2020. “Individual Differences in Distributional Learning for Speech: What’s Ideal for Ideal Observers?” *Journal of Speech, Language, and Hearing Research* 63 (1): 1–13.
Tzeng, Christina Y, Lynne C Nygaard, and Rachel M Theodore. 2021. “A Second Chance for a First Impression: Sensitivity to Cumulative Input Statistics for Lexically Guided Perceptual Learning.” *Psychonomic Bulletin & Review* 28: 1003–14.
Xie, Xin, T Florian Jaeger, and Chigusa Kurumada. 2023. “What We Do (Not) Know about the Mechanisms Underlying Adaptive Speech Perception: A Computational Framework and Review.” *Cortex*.