A key point of the study is to examine the neural processing of sound during perceptual constancy. We must therefore check whether listeners discriminate sounds equally well when vowels are generated with different fundamental frequencies (F0s), sound levels and voicing parameters, as well as when sounds are presented from different locations.

The plots generated here appear in the paper in Figure 1C and cover the four subjects for which we recorded responses of neurons during task performance:

```
% Subject name
ferrets = {'F1201_Florence','F1203_Virginia','F1217_Clio','F1304_Flea'};

% Subject name, first formant of vowels associated with left and right responses on correct tri
contingencies = {'F1201_Florence', 460, 730;
                 'F1203_Virginia', 460, 730;
                 'F1217_Clio',     730, 460;
                 'F1304_Flea',     437, 936};

% Color scheme
colors = [1 0.5 0;      % Florence
          1 0 0;        % Virginia
          0 0.5 1;          % Clio
          0.5 0.25 0.08];   % Flea

% Minimum number of trials for a stimulus condition to be accepted (for
% each subject)
reqTrials = 40;

% Define path to behavioral data
data_dir = 'C:\Users\steph\Documents\GitHub\perceptual_constancy_for_vowels\data\behavior';
```

Pitch analysis

Compare vowel discrimination performance of each listener as a function of fundamental frequency. Data is shown as a line plot (lines represent different subjects) and the overall performance of each ferret is also printed to the console. Also reported is the probability of observing that performance if responses followed a binomial distribution with equal probability of correct and error responses (i.e. so we can determine if animals were performing significantly better than chance).

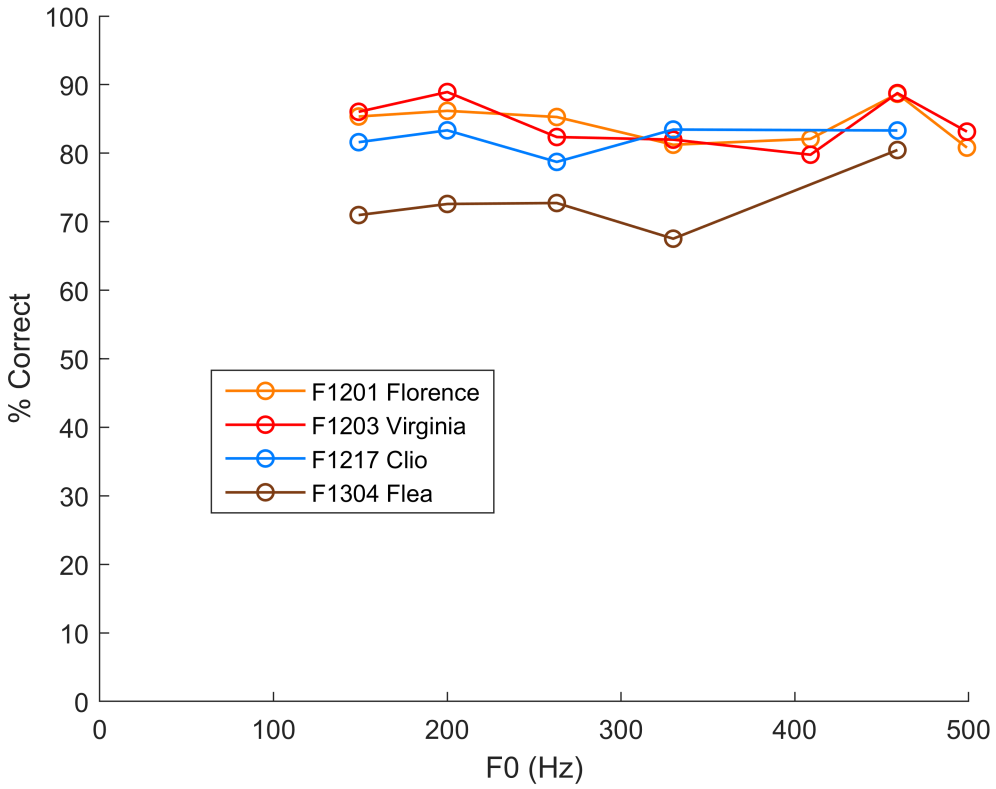
```
% Data directory (change for your machine)
pathname = fullfile(data_dir, 'pitch');

% Define headers for files generated by GoFerret
headers = {'Trial','CorrectionTrial','StartTime','CenterReward',...
            'F1','F2','F3','F4','HoldTime','Atten','Pitch','Side',...
            'Response','RespTime','Correct'};


% Set up figures
figure('name','Pitch Constancy - Behavioral data')
axes('nextPlot','add')
```

```
xlabel('F0 (Hz)')
ylabel('% Correct')
ylim([0 100])
plot(xlim,[50 50],'--k')


% Set up legend names
[legStr, hp] = deal([]);

% For each ferret
for i = 1 : numel(ferrets)

    % List behavioral files (corrected for calibration
    ferDir = fullfile( pathname, ferrets{i});
    files  = dir( fullfile(ferDir, '*Level*.txt'));
    T = [];

    % Specific continencies
    cIdx  = strcmp(contingencies(:,1), ferrets{i});
    ruleF = cell2mat(contingencies(cIdx,2:3));

    % Build behavioral record
    for j = 1 : numel(files)

        % Skip level 37 files (i.e. sessions where a single vowel token was
        % presented, rather than the two tokens in other sessions)
        if contains(files(j).name,'level37')
            continue
        end

        % Import data
        B = importdata( fullfile( ferDir, files(j).name));

        if isempty(B), continue; end

        % Convert to table
        B = array2table(B.data,'VariableNames',headers);

        % Filter for trial parameters
        B(B.CorrectionTrial == 1,:) = [];   % Remove correction trials
        B(B.Correct == -1,:) = [];          % Remove abort trials

        % Add to all data
        T = [T; B];
    end

    % Escape if no good data
    if isempty(T)
        fprintf('No data for %s\n', ferrets(i).name); continue
    end

    % Run logisitic regression
    mdl = fitglm(T.Pitch, T.Correct,'distribution','binomial');
```

```
    % Run binomial test
    pBinom = myBinomTest(nansum(T.Correct), size(T,1), 0.5);
    fprintf('All data: %s: %d / %d: p = %.5f\n', ferrets{i}, nansum(T.Correct), size(T,1), pBir

    % Get spatial masks
    [nUniqueX, uniqueX, nXUnique] = nUnique(T.Pitch);
    y = nan(nUniqueX,1);

    for j = 1 : nUniqueX
        y(j) = mean(T.Correct(T.Pitch == uniqueX(j)));
    end

    y = y .* 100; % convert proportion to percentage

    % Filter for trial number
    uniqueX = uniqueX( nXUnique >= reqTrials);
    y = y( nXUnique >= reqTrials);

    % Plot performance vs F0
    h = plot(uniqueX, y, '-o',...
            'Color', colors(i,:),...
            'MarkerEdgeColor', colors(i,:),...
            'tag', ferrets{i},...
            'Userdata', nXUnique,...
            'LineWidth', 1);

    % Remember name for legend
   hp = [hp; h];
   legStr = [legStr; {strrep(ferrets{i},'_',' ')}];
end
```

```
All data: F1201_Florence: 10214 / 12032: p = 0.00000
All data: F1203_Virginia: 8502 / 9945: p = 0.00000
All data: F1217_Clio: 3946 / 4792: p = 0.00000
All data: F1304_Flea: 1051 / 1487: p = 0.00000
```

```
myL = legend(hp, legStr);
set(myL,'position',[0.2298 0.3341 0.2518 0.1698])
```


100
90
80
70
60
50
40
30
20
10
0
% Correct
0
100
200
300
400
500
F0 (Hz)
F1201 Florence
F1203 Virginia
F1217 Clio
F1304 Flea