Guide to Data Repository for:
Dewey and Shera (2023) Bandpass shape of distortion-product otoacoustic emission ratio functions reflects cochlear frequency tuning in normal-hearing mice, JARO

Author: James B. Dewey

This document provides a guide to accessing and plotting data stored in **Dewey_2023_JARO_raw.mat** and **Dewey_2023_JARO_figs.mat**, MATLAB files that can be downloaded from https://github.com/jbdewey/Dewey2023JARO. Loading these files gives access to all raw individual data and data plotted in the figures, respectively. These structures and their substructures are described in detail below. Scripts to plot relevant figure panels are also included in the repository.

Please be advised that the data should not be interpreted to address questions that fall outside of the context or scope of the manuscript. Specifically, caution is required when comparing vibratory phases from different structures as we cannot guarantee that all measurements were always obtained at exactly the same longitudinal location in each preparation. A significant amount of time may have passed between any two given measurements, such that the measurement position could possibly have drifted in certain mice. Additionally, for the convenience of accessing and plotting the data, each data structure has indices for all mice, though not all types of measurements were obtained in each. The absence of a measurement is indicated by the presence of NaNs in a given array. All response magnitudes are root-mean-square (RMS) values (either nm or Pascals), and phases are in cycles. Phases have been referenced to the stimulus phase measured in the ear canal, as described in the manuscript.

If you require any assistance in accessing or interpreting the data, please e-mail jamesdew@usc.edu.

I. RAW DATA

Loading **Dewey_2023_JARO_raw.mat** gives access to the **apical_data**, **mid_data**, and **model_data** structures, which are described below.

A. Apical data

Data obtained from the 9 kHz location or from the ear canal with an f_2 of 9 kHz are stored in the **apical_data** structure. This structure includes the following fields/substructures:

mouse_IDs % mouse identification numbers
single_tone_10dB % vibration data from BM, OHC region, and TM obtained with single tones (10 dB steps)
single_tone_5dB % vibration data from BM, OHC region, and TM obtained with single tones (5 dB steps)
two_tone_LEQ_10dB % vibration and ear canal data obtained with f_2 and f_1 presented at the same level and varied in 10 dB steps
two_tone_LEQ_5dB % vibration and ear canal data obtained with f_2 and f_1 presented at the same level and varied in 5 dB steps
two_tone_LVAR_5dB % vibration and ear canal data obtained with f_2 presented at 60 dB SPL and the f_1 tone varied in level in 5 dB steps

Single-tone responses

Substructures containing vibratory responses to single tones (**single_tone_10dB** and **single_tone_5dB**) include the following:

f1s % stimulus frequency (Hz)
L1s % stimulus levels (dB SPL)
BM % substructure containing BM responses
OHC % substructure containing OHC region responses
TM % substructure containing TM responses

Vibration data from a given location (e.g., the BM) can be accessed in:
apical_data.single_tone.BM.vib.f1, which contains:

mag % displacement magnitude (nm RMS)
magC % 'clean' displacement magnitudes (i.e., those meeting the measurement noise floor criterion)
phi % displacement phase (cycles)
phiC % clean displacement phases
nf_ave % average displacement noise floor in surrounding frequency bins
nf_sd % standard deviation of the noise floor
q10 % Q_{10dB} values
qerb % Q_{ERB} values

Displacement data are arranged by stimulus frequency x stimulus level x mouse and *Q* values are arranged by stimulus level x mouse.

The indices of mice with data for a given location (e.g., the BM) are found in:
apical_data.single_tone.BM.mouse_i

Two-tone responses

Substructures containing vibratory and/or ear canal responses to two tones (**two_tone_LEQ_10dB**, **two_tone_LEQ_5dB**, and **two_tone_LVAR_5dB**) include the following:

f1s % f_1 stimulus frequency (Hz)
f2s % f_2 stimulus frequency (Hz)
L1s % f_1 stimulus level (dB SPL)
L2s % f_2 stimulus level (dB SPL)
BM % substructure containing data obtained during BM measurements
OHC % substructure containing data obtained during OHC region measurements
TM % substructure containing data obtained during TM measurements
RME % substructure containing ear canal data obtained with the RME audio interface, without an accompanying vibration measurement

For a given cochlear measurement location (e.g., the BM), ear canal and vibration data are accessed in **apical_data.two_tone_LEQ_10dB.BM.mic** and **apical_data.two_tone_LEQ_10dB.BM.vib**, respectively. The **RME** substructure only contains ear canal data (e.g., **apical_data.two_tone_LEQ_10dB.RME.mic**).

Each **vib** and **mic** substructure includes responses at f_2, f_1, and $2f_1$-f_2 in the **f1**, **f2**, and **dp** substructures, respectively, which contain the following:

mag % response magnitude (either root-mean-square nm or Pascals)
magC % 'clean' response magnitudes
phi % response phase in cycles
phiC % clean response phases
nf_ave % average noise floor in surrounding frequency bins
nf_sd % standard deviation of the noise floor
q10 % Q_{10dB} values (only included for $2f_1$-f_2)
qerb % Q_{ERB} values (only included for $2f_1$-f_2)

The indices of mice with data for a given location (e.g., the BM) are found in:
apical_data.two_tone_LEQ_10dB.BM.mouse_i

B. Mid-cochlear data

Data obtained from the ~20-23 kHz location or from the ear canal with an f_2 of 20-23 kHz are stored in the **mid_data** structure. This structure is organized in the same way as the apical data structure, though with the addition of fields specifying the CF (20-23 kHz), location of the vibratory measurements (BM or top of the organ of Corti (OOC)) and f_2 frequency, which varied across mice. For single-tone responses, data were only obtained in 10 dB steps. For two-tone responses, only ear canal data are available (in the '**RME**' substructure). To summarize, substructures for the mid-cochlear measurements therefore include:

mouse_IDs % mouse identification numbers
cfs % characteristic frequencies of the cochlear measurement sites (Hz)
f2s % f_2 stimulus frequency (Hz)
locs % Measurement location (BM or OoC)
single_tone_10dB % vibration data from BM, OHC region, and TM obtained with single tones (10 dB steps)
two_tone_LEQ_10dB % ear canal data obtained with f_2 and f_1 presented at the same level, and varied in 10 dB steps (only obtained in one mouse)
two_tone_LEQ_5dB % ear canal data obtained with f_2 and f_1 presented at the same level, and varied in 5 dB steps

C. Model data

Average BM responses to single tones from the ~9 kHz location were extrapolated to estimate the spatial magnitude and phase profiles of traveling waves at f_1 and f_2 in our simple model of DP generation. These average displacement responses are included in the **model_data** structure, which contains:

mm_re_bp % mm relative to the 'best place' of a given frequency (i.e., the peak of the traveling wave), with negative values referring to more basal locations
L1s % stimulus levels (dB SPL)
mag % displacement magnitude (RMS nm)
phi % displacement phase (cycles)

Displacement magnitudes and phases are organized by cochlear distance x stimulus level.

II. FIGURE DATA

Loading **Dewey_JARO_2023_figs.mat** gives access to data contained in most figure numbers/panels, which are stored in the following structures:

fig2
fig3
fig4
fig5
fig6
fig7
fig8
fig9

Scripts for plotting the data in each of the aforementioned figures are provided in the repository (e.g., **fig2a_d_plot.m** plots panels A-D of Fig. 2).

Data in each figure panel can be accessed as described in the following sections.

Fig 2 (fig2a_d_plot.m)

(a-d) Data in each panel are stored in the following structures where the letter after the figure number indicates the panel. Panel letters are followed by the abbreviation for the measurement location ('EC' = ear canal, measured with the RME or NI/OCT system).

fig2.a.BM
fig2.b.OHC
fig2.c.TM
fig2.d.EC

Substructures for panels A-C contain the following variables:

mouse_ID % mouse ID
f1s % stimulus frequencies (Hz)
L1s % stimulus levels (dB SPL)

The substructure for panel D contains the additional variables:

f2s % f_2 stimulus frequencies (Hz)
L2s % level of f_2 tone (dB SPL)

Each panel/location substructure contains a **vib** or **mic** substructure with the plotted vibration or ear canal data, for example:

fig2.a.BM.vib.f1.magC % Clean BM displacement magnitudes (nm RMS)
fig2.a.BM.vib.f1.phiC % Clean BM displacement phases (cycles)
fig2.d.EC.mic.dp.magC % Clean DPOAE amplitudes (Pascal RMS)
fig2.d.EC.mic.dp.phiC % Clean DPOAE phases (cycles)

Data are arranged by frequency x stimulus level.

Fig 3 (fig3a_d_plot.m)

(a) Data are stored as described in Fig. 2. Vibration and ear canal data are stored in:

fig3.a.BM.vib.f1.mag % Raw BM displacement magnitudes (nm RMS)
fig3.a.BM.vib.f1.magC % Clean BM displacement magnitudes
fig3.a.EC.mic.dp.mag % Raw DPOAE amplitudes (Pa RMS)
fig3.a.EC.mic.dp.magC % Clean DPOAE amplitudes

(b) Q_{10dB} values for each measurement location are accessed in:

fig3.b.BM.vib.f1.q10
fig3.b.OHC.vib.f1.q10
fig3.b.TM.vib.f1.q10
fig3.b.EC.mic.dp.q10

Stimulus levels are provided under each location's substructure (e.g., **fig3.b.BM.L1s**).

(c) Q_{10dB} data for each measurement location are provided as follows (e.g., for the BM):

Fig3.c.BM.mouse_IDs % mouse IDs
Fig3.c.BM.L1s % stimulus levels (dB SPL)
fig3.c.BM.vib.f1.q10_ind % all individual values (not plotted; stimulus level x mouse)
fig3.c.BM.vib.f1.q10_ave % average Q_{10dB}
fig3.c.BM.vib.f1.q10_ci % 95% confidence interval

(d) Q_{ERB} data are provided as described in **(c)**, with 'q10' replaced by 'qerb'.

Fig 4 (fig4b_g_plot.m)

(b) Data provided as in Fig 2. Raw and clean BM displacements are accessed in **fig4.b.BM.vib.f1.mag** and **fig4.b.BM.vib.f1.magC**.

(c) Apical and mid-cochlear BM displacements normalized to the stimulus pressure are provided in:

fig4.c.apical.BM.vib.f1.gainC % apical gain (dB re 1 nm/Pa)
fig4.c.mid.BM.vib.f1.gainC % mid-turn gain

with stimulus frequency and level for each measurement location provided in, for example, **fig4.c.mid.BM.f1s** and **fig4.c.mid.BM.L1s**.

(d) DPOAE data are provided as in Fig 2, with clean DPOAE amplitudes and phases provided in **fig4.d.EC.mic.dp.magC** and **fig4.d.EC.mic.dp.phiC** (stored as frequency x level).

(e) Data provided as in Fig 3(a).

(f) Data provided as in Fig 3(b).

(g) Data provided as in Fig 3(c).

Fig 5 (fig5a_h_plot.m)

Spectra for panels **(a-h)** are located in (e.g., for the BM):

fig5.a.BM.vib.spec_f % frequency (Hz)
fig5.a.BM.vib.spec_mag % Displacement (nm RMS)

or, for ear canal measurements:

fig5.d.EC.mic.spec_f % frequency (Hz)
fig5.d.EC.mic.spec_mag % Pressure (Pa RMS)

Fig 6 (fig6a_d_plot.m)

(a-d) Vibratory and ear canal responses are provided largely as described in Fig 2, with the exception that both types of measurements include responses to two-tone stimuli. For example, BM vibratory data at the DP frequency are accessed in:

Fig6.a.BM.vib.dp.mag % Raw displacement magnitude (nm RMS)
Fig6.a.BM.vib.dp.magC % % Clean displacement magnitude
Fig6.a.BM.vib.dp.phi % % Raw displacement phase (cycles)
Fig6.a.BM.vib.dp.phiC % Clean displacement phase

Stimulus frequencies and levels are provided in the substructure for each location. For displacement data, phases of the estimated local DP and of single tone responses are provided in (e.g., for the BM) **Fig6.a.BM.vib.dp_gen** and **Fig6.a.BM.vib.st**, respectively. Stimulus frequencies for single-tone response phases are provided in **Fig6.a.BM.st_f1s**.

Fig 7 (fig7a_d_plot.m)

(a-d) Individual and average response magnitude data are provided largely as described for Fig 6. For example, DP displacement magnitudes for the BM are provided in:

fig7.a.BM.vib.dp.magC_ind % individual clean displacement magnitudes (nm RMS; not plotted, arranged by frequency x level x mouse)
fig7.a.BM.vib.dp.magC_ave % average clean displacement magnitudes (arranged by frequency x level)
fig7.a.BM.vib.dp.magC_se % SE of the clean displacement magnitudes (arranged by frequency x level)

DPOAE amplitudes are provided in:

fig7.d.EC.mic.dp.magC_ind % individual clean DPOAE amplitudes (Pa RMS; not plotted, arranged by frequency x level x mouse)
fig7.d.EC.mic.dp.magC_ave % average clean DPOAE amplitudes (arranged by frequency x level)
fig7.d.EC.mic.dp.magC_se % SE of the clean DPOAE amplitudes (arranged by frequency x level)

Mouse IDs, stimulus frequencies, and stimulus levels are the same for all locations but are provided for each measurement location substructure (e.g., **fig7.d.EC.f1s**).

Fig 8 (fig8a_d_plot.m)

(a-d) Data are provided as described for Fig 6.

Fig 9 (fig9a_d_plot.m)

(a-d) Data are provided as described for Fig 7.