

## Adaptive Music Perception (AMP) test

### Key references:

Kirchberger, M.J., & Russo, F.A. (2015). Development of the Adaptive Music Perception test. *Ear and Hearing*, 36(2), 217-228. doi:10.1097/AUD.0000000000000112

Levitt, H. C. C. H. (1971). Transformed up-down methods in psychoacoustics. *The Journal of the Acoustical society of America*, 49(2B), 467-477.

### Download link for scripts:

<http://smartlaboratory.org/resources/amp-test/>

### Installation:

Unzip the folder and move the entire folder to any directory you like.

### Equipment:

Computer with MATLAB installed; a loudspeaker; a computer touchscreen (ideal) or an extended screen with a mouse.

### Setup:

The loudspeaker should be at least 70 cm away from the participant (though ideally 1.0-1.5 m), at head height and 0° azimuth.

### To run the AMP test:

Open MATLAB.

Change the directory to the (root) folder of AMP, either by browsing to this folder using the address bar, or by typing `cd '<insert full file path to AMP folder here, e.g., Users/smartlab/Documents/AMP>'` in the command window.

Make sure MATLAB is set to the AMP root/main folder, otherwise the initial calibration data won't save properly.

Type **AMP** in the MATLAB command line.

Select language (English or German).

Enter participant ID.

Select listening condition, either 'with HA' (aided) or 'no HA' (unaided). The calibration file and participant data files will be saved with `_noHA` or `_withHA` appended at the end of the file name.

The test window should be extended from the experimenter's screen onto the participant's screen, or the two screens can be shared with all other windows hidden except for the test GUI.

Note about AMP adaptive procedure:

The AMP program requires at least 6 "reversals" for a particular dimension and calculates the participant's threshold based on the average value of the last 4 "reversals". The number of reversals needed by the AMP program and the number of reversals the AMP uses to calculate a participant's threshold are found in each test script (e.g., `meter_test.m`), labelled as variables `param.reversals` and `param.lastrev`, respectively. These numbers can be changed in the scripts, with a larger number of reversals requiring more time for the test to be completed and a smaller number of reversals requiring less time. Note that Kirchberger and Russo (2015) used six reversals, with the threshold calculation based on the last four reversals.

## **Calibration**

An initial calibration must always be performed to determine the participant's +40 dB sensation level, i.e., a sound level 40dB higher than their hearing threshold *without* hearing aids. The calibration tone is a 220-Hz complex tone (see Kirchberger and Russo (2015) for more detail). Once that level has been calibrated for a participant, the calibration number is saved as a .mat file in `~/AMP/calib`, and the same participant can be tested using this data without redoing calibration.

If the participant normally wears hearing aids, calibration should be done without aids.

Note that the calibration file saves as "`<participant-id>_noHA`" if the "No HA" option is selected in the calibration window, or as "`<participant-id>_withHA`" if the "With HA" option is selected. The same calibration file can be re-used as long as you type in the same `<participant-id>` and No HA/With HA selections, and the calibration file is left in the `~/AMP/calib` folder. See "After the experiment session" for more calibration-related notes.

If the participant's audiometric thresholds are very high at 250 Hz, or if they can't hear the starting tone during calibration, open the `music_calibration.m` script inside `~/AMP/programs` and change the initial level from -30 to -20 or an even easier level. Save changes and make sure that MATLAB is set to the AMP root folder as usual.

If the program can't find the calibration data for a participant being tested, the subtest buttons in the test GUI will flash orange as a warning, and there will be a warning message in the MATLAB command window "No previous calibration data".

Instructions to participant: The computer will try to figure out the softest sound you can hear. You will see these two buttons light up, one at a time. One of the buttons will have a sound playing. Choose the button that has a sound. The sound will get softer and softer, until you have to guess which button has the sound.

Note: The initial calibration will take about 5 minutes. It will take longer if the participant tends to make errors early on in the adaptive process.

## **Subtests**

When testing participants in a hearing-aided condition, ask the participant to set their hearing aids to the program normally used for listening to music, if their hearing aids have such a program.

### **Subtest: Meter**

Instructions to participant: You will hear six notes. I would like you to decide whether the notes are in a two-beat or three-beat rhythm (demonstrate by tapping on table: A two-beat rhythm is ONE-two-ONE-two-ONE-two, and a three-beat rhythm is ONE-two-three-ONE-two-three).

Training set: Let's do some practice. A correct answer will flash green. A wrong answer will flash red. Tap on 'Start' to begin. Tap 'Continue' to go on.

After practice: The test set will be longer than the practice set, and it won't tell you whether you got it right or wrong. It will get more difficult to decide which one it is as you go on. When you aren't sure whether it's a two- or three-beat rhythm, I'd like you to guess. It will take at least 10 minutes to finish, perhaps a little longer. If you need to take a break, don't press 'Continue'.

### **Subtest: Harmony**

Note: The official instruction on the screen is to identify which cadence sounds less resolved. Participants without music training rarely understand the term “resolved”; alternative terms are “warbly” or “clashing” or “dissonant” for the Dissonance condition, and “out-of-tune” for the Intonation condition.

Instructions to participant: You’ll hear two melodies, A and B. One of the melodies ends in a chord that sounds right, it’s a good ending. The other melody ends in a chord that sounds out of tune, or dissonant. There’s something wrong with it compared to the other chord. Choose which one is the one that’s not quite right.

Training set: Let’s do some practice. A correct answer will flash green. A wrong answer will flash red. Tap on ‘Start’ to begin. Tap ‘Continue’ to go on. (If participant needs coaching during the practice, point out the ending chord that has a “warbly” quality or “out of tune” quality.)

After practice: The test set will be longer than the practice set, and it won’t tell you whether you got it right or wrong. It will get more difficult to decide which one it is as you go on. When you aren’t sure which ending is the one that doesn’t sound right, I’d like you to guess. It will take at least 10 minutes to finish, perhaps a little longer. If you need to take a break, don’t press ‘Continue’.

### **Subtest: Melody**

Note: The Melody subtest tends to be difficult for non-musically trained participants. We recommend (a) omitting this subtest for musically naïve participants, or (b) run the test twice (treat the first run as practice).

Instructions to participant: You’ll hear two melodies. The second melody is transposed down compared to the first melody, but it might have the same contour or a different contour. You have to decide whether the first and second melodies have the same or a different melodic contour, ignoring the fact that the second melody is transposed. There will be a chord playing in the background as well. The melodies will become softer, until you’ll have to guess whether they’re the same or different.

### **Subtest: Timbre**

Note: The perceived loudness for different timbres needs to be adjusted before the Timbre subtest.

Instructions to participant for calibration: We need to adjust the volume of different notes for this task. You’ll hear two notes. Adjust the volume of the second note until it’s as loud as the first note (indicate slider). You can play the two notes as many times as you need to compare them.

Note: If the participant finds the instructions difficult to follow, the experimenter can take them through the procedure by playing each pair of notes, asking whether the second note is louder, softer, or the same as the first note, and adjusting the slider for the participant.

Instructions to participant for task: You’ll hear two notes, A and B, then a third mystery note X. Was X like A, or like B? Tap on either A or B to put in your answer. At some point, you may have to guess whether X is A or B.

### **After the experiment session:**

The calibration file is saved in `~/AMP/calib/`. This file contains both the initial sound level calibration data and the timbre calibration data. Leave the calibration file in the `~/AMP/calib/` folder if the same participant will be tested again.

If the participant wears hearing aids, the same calibration file should be used for both Unaided and Aided test sessions. As noted above, there is typically only a single calibration file and it is created without hearing aids. To use the same calibration file for different conditions (e.g., aided), make a copy of the same file and relabel it with the other condition (e.g. relabel a copy of `AMP26_noHA.mat` as `AMP26_withHA.mat`). Leave both calibration files in the calibration folder until the participant finishes both aided and unaided test sessions.

The final data for all subtests are saved in **~/AMP/results**. If the participant's ID was entered as **AMP26** in the 'no HA' condition, the data files will include an Excel file **AMP26\_noHA.xls**, a MATLAB Data file **AMP26\_noHA**, a MATLAB figure file for the initial sound level calibration **AMP26\_noHA\_calib**, and one MATLAB figure file for each subtest tested, **AMP26\_noHA\_D1**, **AMP26\_noHA\_D2**, etc.

D1 = Meter (Level), D2 = Meter (Frequency), D3 = Meter (Duration),  
 D4 = Harmony (Dissonance), D5 = Harmony (Intonation),  
 D6 = Melody-to-Chord Ratio I (lower pitch), D7 = Melody-to-Chord Ratio II (higher pitch)  
 D8 = Timbre (Brightness), D9 = Timbre (Attack), D10 = Timbre (Spectral Irregularity)

An example Excel file looks like this:

Discrimination thresholds									
D1 (dB)	D2 (Hz)	D3 (sec)	D4 (Hz)	D5 (Hz)	D6 (dB)	D7 (dB)	D8 (dB/har)	D9 (sec)	D10 (dB)
0.984375	0.475	0.03125	0.21	0.35			-0.19375	0.025	-1.82813
Calibration (dB)									
-43.25									

In this instance, the value of D1, 0.984375, was calculated as an average of the last four "reversals" in the adaptive procedure. Note that D6 and D7 (Melody Subtest) were omitted from testing in this example. This omission was based on our recommendation to avoid the Melody Subtest for musically naïve participants (e.g., participants with < 5 years of musical training).

And here below are examples of adaptation curves for the calibration and for all 10 subtests:









