

AUDL GS08/GAV1: Laboratory exercise

Adaptive tracks and psychometric functions

The purpose of this assignment is familiarise you with the notion of psychometric functions and adaptive tracks from psychoacoustic testing, plus give you some experience in manipulating data in Excel and/or SPSS. You will be using a special purpose computer program (SHaPS), written specifically to run a wide variety of discrimination tests. Here, we use it to measure the minimal detectable gap in a white noise that you can hear.

Commands for using SHaPS to run a test

1. Double-click on the 'Lab Programs' icon on the left of the screen
2. Double-Click on the blue **SHaPS** icon
3. Right click mouse → Session
4. Enter a name and code. Ensure there are no spaces in the code. Click 'Done'
5. Navigate to the folder '**C:\Users\B07_Lab\Documents\AUDL4007 gaps**' and ...
6. Select the gap detection task by selecting 'Gaps.txt'
7. On the display of stimulus parameters: Options → Confirm
8. Run the test!
9. Go back to step 4 and run another test exactly the same way.

Commands for using RShell in SHaPS to analyse the results

1. Right click mouse → RShell
2. Right click mouse → Choose a script
3. Navigate to the directory: **\Temp_Data\AUDLGS08-GAV1 gaps** and choose the file **SHaPS3_gaps_11NOV2015.R**
4. Right click mouse → Choose one or more data files
5. Navigate to the directory:
C:\Users\B07_Lab\Documents\AUDL4007 gaps\Results\YourCode
6. Select the two .csv files.

There are two files that are generated from each test, to be found in the folder:
C:\Users\B07_Lab\Documents\AUDL4007 gaps\Results\YourCode

The .csv files can be opened in Excel. They contain the trial-by-trial results from the task, with the following information (don't worry about the values that are not explained further):

Trial: trial number

~~**Track; Level; Continuum**~~

Standard: stimulus number on the continuum for the fixed stimulus (no gap)

Comparison: stimulus number on the continuum for the comparison stimulus (with a gap)

Accuracy: 1 if correct and 0 if incorrect for that particular trial

~~**Direction; LevittCount**~~

Reversals: reversal number

StepSize: the amount by which the comparison stimulus will change, if required

~~**RespTime; TrialType; Time**~~

Answer: the position of the noise with the gap (Left, Middle or Right)

RespKey: the response given by the listener

Once you start manipulating these files, save them as Excel files (.xls or .xlsx) so you can preserve the work you do in them.

The stimulus continuum is numbered from 0 to 40, where stimulus 0 is the standard stimulus that has no gap. The rest of the stimuli all have gaps, with stimulus 1 having a gap of 0.5 ms (pretty much impossible), and stimulus 40 having a gap of 30 ms (really easy). The gap durations are spaced logarithmically in between, so changing by a constant ratio from one stimulus to the next. You can convert any particular stimulus number, call it N , to the gap it corresponds to using this equation (you must calculate the power before multiplying by the initial '0.5'):

$$0.5 \left[\frac{30}{0.5} \right]^{\frac{N-1}{39}}$$

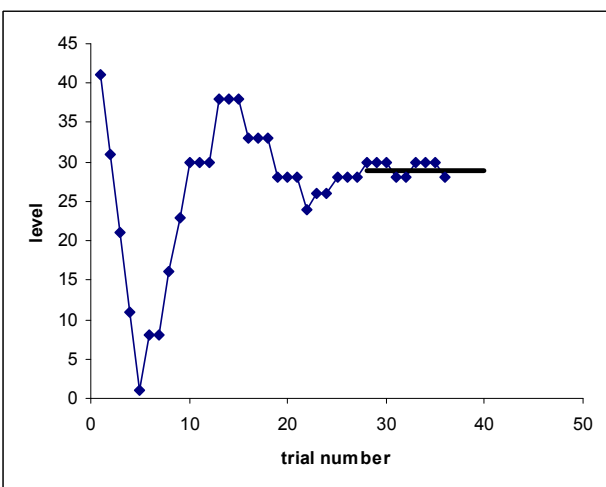
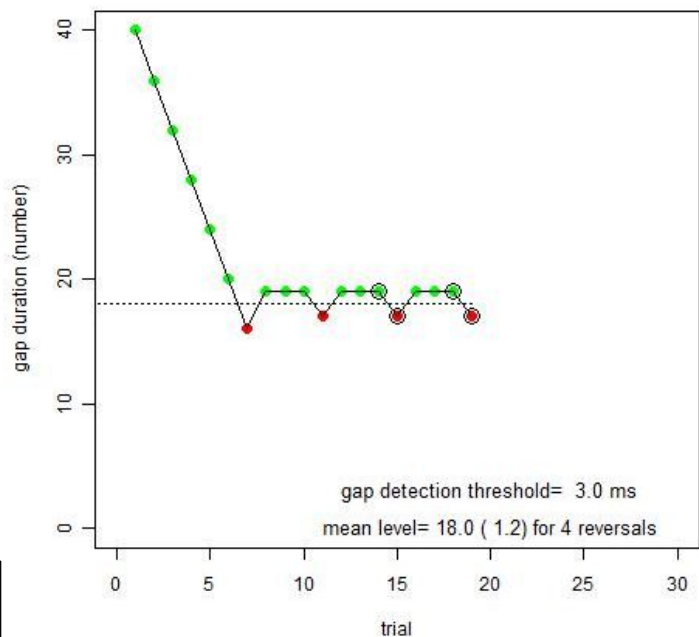
This can be written in Excel as $=0.5*(30/0.5)^{(N-1)/39}$
 For example, $N=18$ means a gap duration of nearly 3.0 ms.

Running RShell results in a number of further files from each test, including two graphs. One plots the adaptive track and the other the psychometric function. These are in the folder:
C:\Users\B07_Lab\Documents\Shaps\ShapsDepot\RshellTemplates\Files\ResultsFiles

Looking at individual adaptive tracks

Here's an example adaptive track which plots the stimulus level as a function of trial number.

Look at your adaptive tracks and work out the rules followed by the tracking algorithm. You may find it useful to consult Levitt (1971) as SHaPS uses a modification of the 3-down 1-up rule (a link for this paper can be found on the course web site). How do step-sizes change throughout the track?



Using Excel, plot the comparison level as a function of trial number. Draw in the threshold calculated from the final 4 track reversals and comment on how well the calculated threshold seems to relate to the track. Compare your track to the one generated in RShell. At left is an example of a track as plotted in Excel (from a different task).

Creating a psychometric function

A psychometric function (PF) is a plot of the performance of listener (usually in proportion correct) as a function of the acoustic feature being manipulated. For this gap detection task, that means performance plotted as a function of gap duration. When the gap is really small, you expect performance to be poor. When it is large, you expect performance to be at or near perfect.

comp	r	n
1	0	1
8	1	2
11	1	1
16	0	1
21	1	3
23	0	1
24	0	1
26	2	7
28	19	29
30	20	21
31	9	9
33	3	3
36	6	6
38	3	3
41	3	3

The first step in plotting a psychometric function is to calculate, for each gap duration, the number of trials that were presented, and how many times the listener made the correct response. At left is an example of the basic data you need to construct a PF.

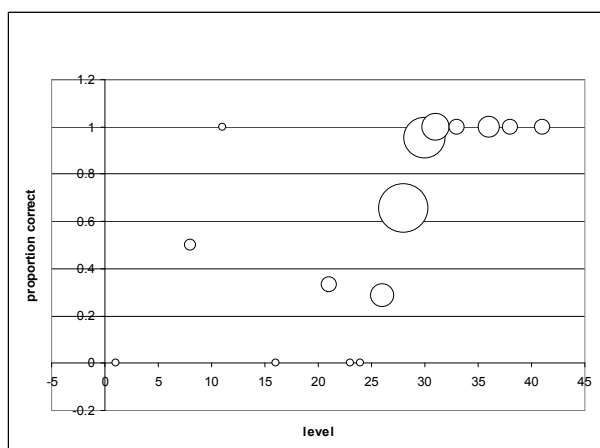
Here **comp** is the level of the comparison stimulus, **r** is the total number correct, and **n** is the total number of trials.

To construct a PF from your own data, first collect together all the trials from the two tracks on a single worksheet, labelling each column appropriately. There are two ways to do the next part of the analysis.

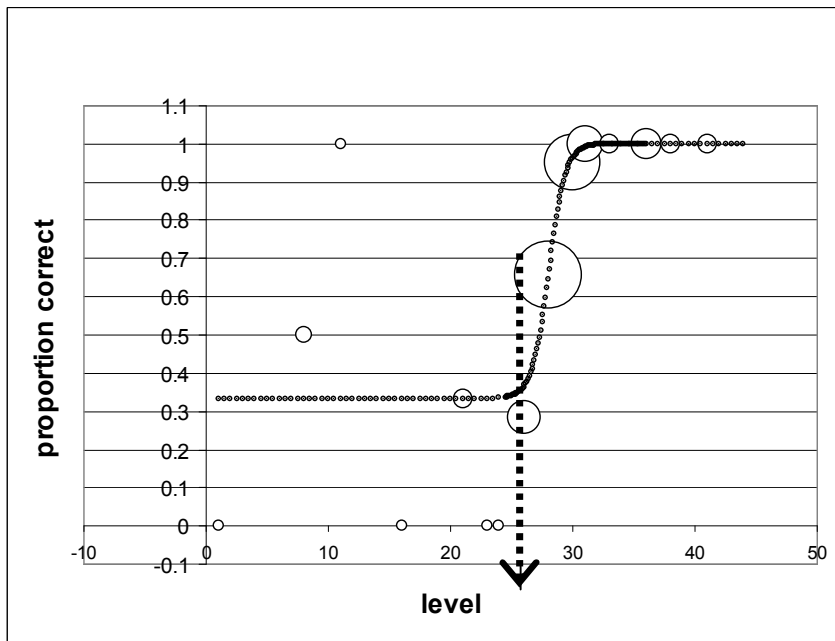
You can do these calculations in Excel but SPSS is a little more fool proof if trickier unless you are used to it. In either case, you are trying to generate a table like the one above.

For SPSS, first open your Excel file in SPSS (you need to specify the appropriate file type in the 'Open Data' window), telling it to read the variable names from the top row. Save away this SPSS file with an appropriate name. You can then get SPSS to tally up your psychometric function using Analyze → Tables → Custom Tables and calculating the sum and count of the appropriate variable (*Accuracy*) for each value of the Comparison. You will probably need to change the Comparison variable to be *Ordinal* and the Accuracy variable to be *Scale*. If you manage it, copy this table into your Excel file on another worksheet.

If you want to use Excel only, it is probably easiest just to sort your table by 'Comparison' and count up the number correct and the total number of trials by hand, in order to construct a table like the one above.



However you do it, you can then calculate the probability of being correct at each comparison level (**p**), and plot your psychometric function using a bubble plot so the size of the points you plot is related to the number of trials at that particular level. In this particular instance, you would see a plot something like this at left:



Sketch a sigmoid (S-shaped) curve by eye to the data points, weighting larger symbols more. Towards the left-hand side, your function should flatten out at chance level ($\frac{1}{3}$) because you used a 3AFC format. Here's an example at left, with a threshold of about 28:

From your fitted psychometric function, determine the stimulus level that leads to 79% correct (the level tracked by the 3-down 1-up rule). How does this compare to the mean threshold of your 2 tracks?

Up until now, you can express all your results in terms of stimulus number on the continuum. Now take your best estimate of the threshold (perhaps an average of the 2 tracks and your estimate from the psychometric function). Convert those to genuine physical values by using the equation above (here the gap duration in ms), and compare the value with others near you. It should be about 2-3 ms.

What you should be able to do:

- Describe the stimuli and the physical variable that is being manipulated.
- Describe the adaptive psychophysical procedure
- Provide a plot of one adaptive track with the calculated threshold drawn in, and a statement about the correspondence
- Provide your psychometric function in a table
- Provide your psychometric function as a bubble chart with an appropriate sigmoid function drawn in (by hand is fine), and a threshold indicated.
- State the threshold derived from the adaptive tracks, and from the psychometric function
- Determine the threshold, with a comparison of this value to what we might expect from previous studies (~2-3 ms).

You need not hand in this work. The important thing is to do it.

Levitt, H. (1971). Transformed up-down methods in psychoacoustics. *Journal of the Acoustical Society of America*, 49, 467-477.