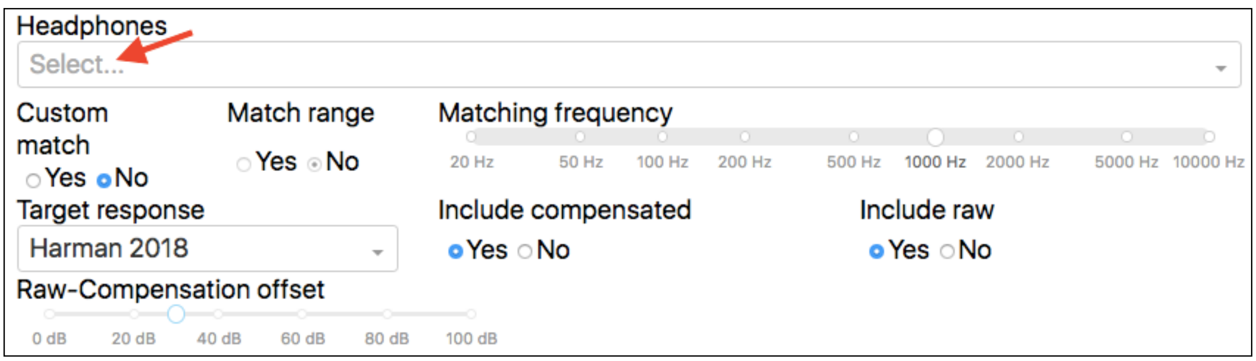
Using Oratory Grapher Headphone

Scenario: to make things less abstract we'll work with the following fictitious scenario. You're looking to buy the best sounding headphone you can afford with a ceiling around $150US. You've done your homework and you now have a short list of:

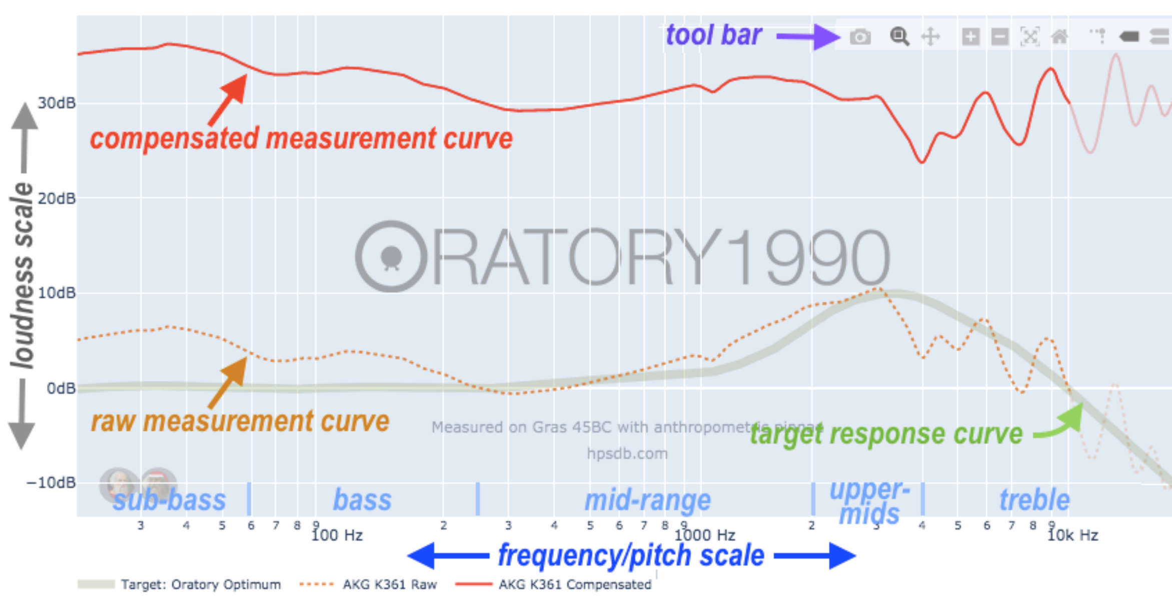
- AKG K361
- Audio-Technica ATH-M40X
- Grado 60e
- Philips SHS9500
- Sennheiser HD 598CS

But review and forum sound descriptions are all over the map. Is this headphone bass-light? Is that headphone piercing? Does this other headphone have a small soundstage? There doesn't seem to be a lot of consensus. Then you discover the Headphone Database and Oratory Grapher Headphone. It looks ultra-technical, but you've read that headphone graphs can tell a lot about how a headphone sounds. To be clear, the graphs at Oratory Grapher are focused on the "tuning" or frequency response. They don't cover sound stage, dynamics, etc. Let's dig in.

Click on the word Select in the Headphones dropdown, then scroll down or start typing the first headphone model name on your list:



This results in the following graph (with labels added):

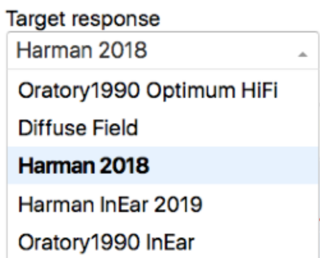


The basic concept is that loudness is on the up-down axis, while pitch/frequency is on the left-right axis.

Looking at the bottom portion of the light blue area, the green curved line labelled target response curve is a reference that you select so you can compare the displayed headphone measurements to a known standard. The dotted orange line, labelled raw measurement curve is the headphone measurement data. This is how this model headphone — the AKG K361 — actually does sound, according to the ultra-pricey measurement equipment that acoustic engineer Oratory1990 uses.

Looking at the upper portion of the blue area, the red line, labelled compensated measurement curve, is a second presentation of the same data. It subtracts the target curve from the actual measurements curve. So the red line shows how far the headphone deviates from the target at each frequency.

Now optionally select an alternate target response curve from the **Target response** box above the graph:



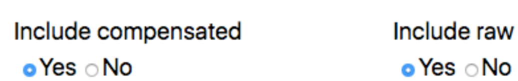
The first three options are for over-ear or on-ear headphones like the ones on the short list. The last two are for in-ear monitors.

- The **Harman 2018** entry is the result of painstaking research into listener preference. The rise in loudness on the left derives from a majority preference for more than a theoretically accurate, or flat-line, bass. The rise on the right simply reflects that the particular shape of our ears acts to amplify the loudness of high frequencies. The Harman target is for people who like their bass but who also like their instrumentals and vocals to sound realistic.
- The **Diffuse field** entry was not intended to be a headphone response target. Instead, it's the response of a hypothetical average human ear to equal-amplitude sound coming equally from all directions. In other words, it's part of the raw data from which headphone targets are derived. It doesn't factor in things like the acoustics of a room or concert hall. But in previous years, before these things were well understood, many people got used to looking at diffuse field compensated headphone frequency graphs so they find it useful, nonetheless.
- The **Oratory1990 Optimum HiFi** entry is acoustic engineer Oratory1990's own contribution. Based on ear response and room acoustics research, this is a carefully considered take on the most accurate/flat/neutral headphone frequency response for a hypothetical average pair of human ears. In fact, it agrees very well with the Harman target once the bass elevation on the right of the Harman target is removed. Oratory optimum also makes sense for use with planar magnetic headphones, which most people find to do just fine with their naturally flat-line bass.

None of these targets is meant to be taken as a final authority on correctness. They were all created from data from the entire population, both male and female, mashed together. Unless you're a diffuse field veteran, for listening with on-ear and over-ear headphones, choose the Harman if you know you're after a headphone that is not shy about its bass delivery. Choose the Oratory optimum target if you find elevated bass undesirable. Either way you need to mentally dial in the amount of bass that's right for you. Similarly, you may be treble sensitive on the one hand or getting on in years on the other, so your personal target will include either less or more elevation on the right side of the graph, as well.

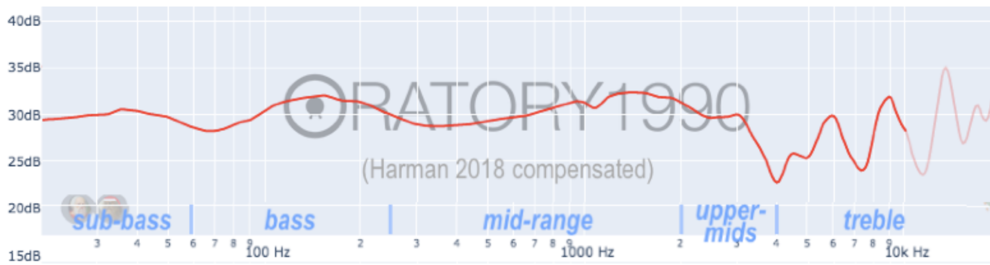
But the first headphone on the shopping list is the AKG K361, which was developed precisely to match the Harman target as closely as possible. So it's interesting to select the **Harman 2018** option to see what that match-up looks like.

Just to the right of the target response selector is:



Now that you understand that the upper, compensated graph just shows the headphone's departure from your chosen target, you may well prefer to simplify the presentation and change **Include raw** to **No** or **Include compensated** to **No**.

Having adjusted the presentation to taste, we can now look at the K361's frequency performance:

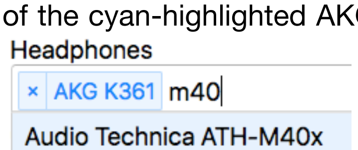


We see that the upper portion of the bass and the highest register of the soprano vocal range (1000 to 2000 Hz) in the mid-range both have a moderate loudness boost. While everything past 3000 Hz is up-and-down, but mostly down. A smooth line is always preferable, but in this case most of what's called the sibilance range is reduced. While not ideal, this does spare us from hissy S's and T's. And for rock and metal lovers, all those flights up the neck of the electric guitar will be a little less piercing.

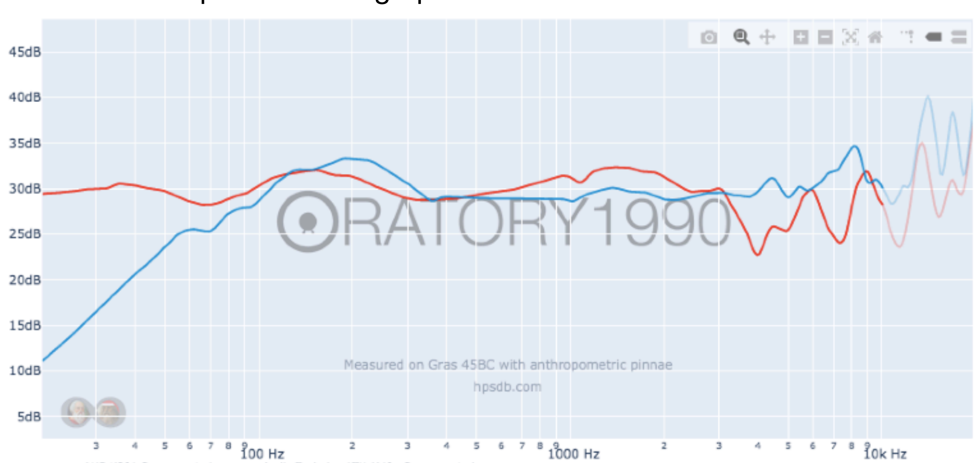
Unit variance: while the measurement curve presented for a headphone looks precise and authoritative, in fact, it often shows the frequency response of a single unit of that headphone model. In the best case, the measurements of more than one unit of the same model have been averaged together. There is always some manufacturing variation from one unit to the next for any model headphone and even between the left and right ear cups. Typically, this variation is in the range of one to three decibels at any given frequency and mostly comes from the actual sound-producing components called the drivers.

Positioning: In addition, the exact loudness measured at a particular frequency for any on-ear or over-ear headphone can vary to a surprising degree, depending on the exact positioning of a person's outer ear within the ear cup. The measurement curve shows the optimal result found from multiple re-positionings. Typically, this variance mostly affects frequencies below 100 Hz and above 2 or 3 kHz.

Next up, let's go back to the Headphones selection box. By simply clicking on the empty space to the right of the cyan-highlighted AKG K361 we can select a second headphone from the dropdown list:

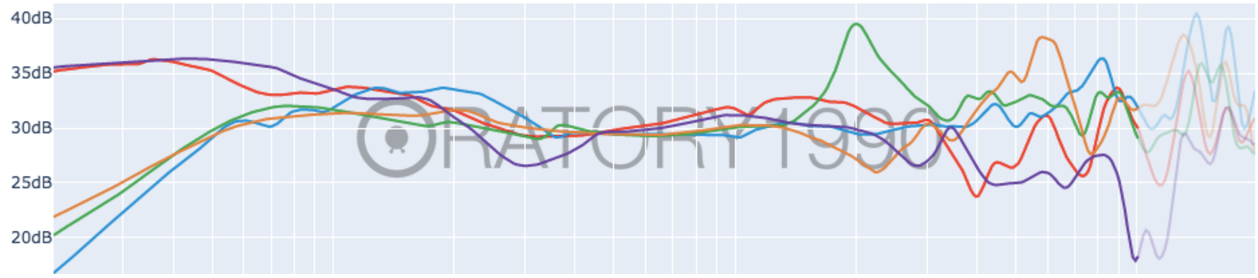


This adds a second headphone to the graph:



Now, not only can we see how the M40x departs from the Harman target, we can see how its departures compare to those of the K361. The dramatic plunge of the blue line of the M40x on the left looks bad. It helps to realize that few instruments and no vocals reach that low. On the other hand, the M40x's flatness out to 6000 Hz is admirable. But the rise at 8000 Hz could be enough to bother a certain fraction of the population with a sensitivity in that area.

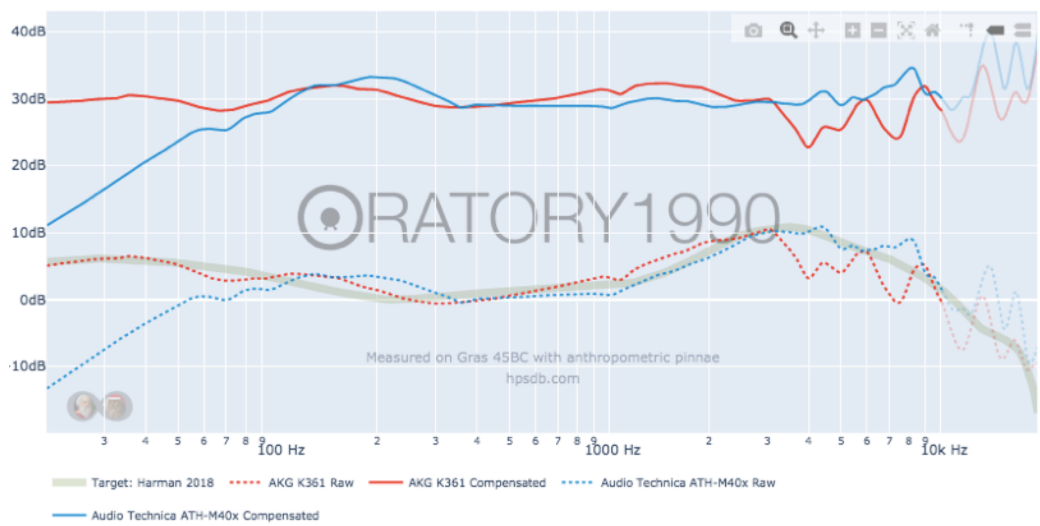
We can add up to three more headphones in this manner. Each is assigned a different colour, but the result can nevertheless be visually confusing:



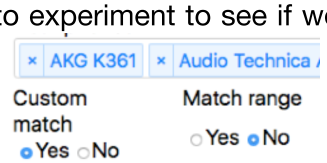
However, simply pointing at any of the coloured spaghetti strands with your mouse point shows the name of that headphone (as well as single-point measurement numbers). This can help greatly in keeping track of which strand of spaghetti belongs to which headphone.

By the way, notice how the measurement lines fade past the 10 kHz point on the right. This is because the measuring equipment used is not certified for accuracy past this point. And in any case, each individual’s hearing increasingly departs from the norm as we move higher into the high frequencies. So take the zigs and zags you see past 10,000 Hz as being suggestive only.

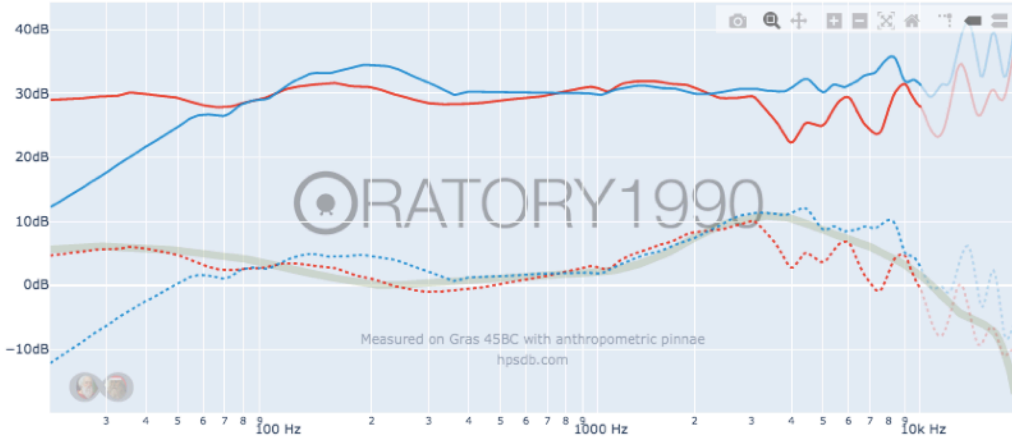
The other control options are there in case you want to customize the presentation. Let’s go back to having just the K361 and M40x displayed, but with the raw graph included:



The automatic alignment logic has overlapped the two graphs so that they touch at several points but separate at others. We might want to experiment to see if we can get more overlap manually. By changing **Custom match** to **Yes**:



then moving the Matching frequency slider or clicking on any of the pre-set buttons we can experiment with different match points:

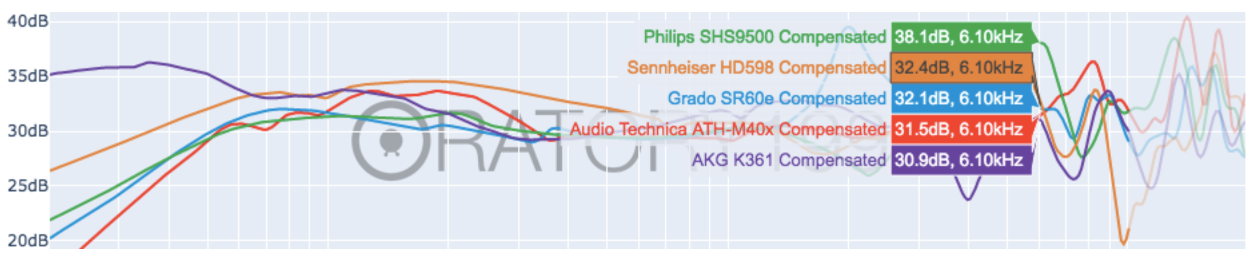


Here I feel I've got more of the mid-range more closely aligned. But now the differences in the upper bass and sibilance regions are somewhat more pronounced. We can also match a range of frequencies to see whether we like the results we get from that better.

Another aspect of the display we can customize is the distance between the raw and compensated graphs when we have both showing at once. This is done with the **Raw-compensation offset** control. A smaller separation offset not only brings the two graphs closer together, it also compresses the loudness scale. While a larger offset does the opposite.

And that covers the upper control set. Which leaves the toolbar on the upper right corner of the graph:

The left-most option, 📷, saves a snapshot of the current graph area to an image file on your own computer. The other icons are there for those who want to get down and dirty with the actual numbers at individual points on a graph line. I suspect only a very small percent of Oratory Grapher users will ever need to use any of them. I find them invaluable for rolling my own EQs.



- **Hovering.** Whenever your mouse pointer hovers over a measurement line (raw or compensated) or target curve, the precise value of the nearest measurement is displayed in the appropriate identifying colour. The two rightmost icons control how this hover data is displayed. The default, option is **Show closest data on hover**. The far right icon, **Compare data on hover**, shows the data for all vertically aligned intersection points between a vertical line that tracks with your mouse pointer and any graph lines it crosses.
- **Zooming.** There are three icons for this. I haven't cracked the secret of the magnifying glass, but the plus and minus icons zoom in and out in the usual fashion.
- **Panning.** The crosshairs icon enables press and drag panning once the graph is magnified larger than the blue rectangular display area.
- **Spike lines.** The gallows icon enables dashed coordinate lines plus a measurement line label to accompany the mouse pointer in its travels.
- **Autoscale** and **Reset.** I haven't yet cracked the logic of these two options.

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And that's pretty much a wrap. You, as the fictitious purchaser of a budget headphone, now have plenty of tools at your fingertips to explore and compare the tuning of these five, or any other, headphones.