Headphone Essentials 0:

Introducing the Headphone Essentials series

I started researching headphones when the headband of the Monster Beats I had shelled out good money for and babied accordingly snapped in two places. I was determined that its replacement would be indestructible and produce good sound. My brain boggled to learn that headphones had a large enthusiast following. Their vocabulary and abbreviated product references were frequently baffling, but also intriguing. At the same time my decades as an amateur musician were coming to an end. Increasingly, I found myself listening to, rather than making, music.

Few of us can walk into a local store to try out non-mass-market headphones, and I certainly am not one of them. But I'm also someone with zero on-line shopping, let alone re-selling, skills. So repeated buy-try-return/resell was not an available approach. I needed to get it right the first time, if at all possible. So I repaired the Beats with coat hanger wire and gopher tape then took my time doing purchase research — research that increasingly threatened to become a new gear obsession in its own right.

Upshot: the Headphone Essentials series is my attempt to create the one-stop resource for learning about and researching a quality headphone purchase that I would have gladly used myself had it existed when I was getting started.

The **first three** (*Basics)* units in this series should be useful if you're coming at audio and/or the world of quality headphones without a lot of background, or might benefit from a refresher. **Units 4, 5 and 6** take a deep dive into the single biggest problem area in headphone audio, called frequency response. Then **units 7 and 8** cover a tool called equalization that can be used to solve frequency response problems. But this whole frequency response focus may be a waste of time, depending on your audio focus.

Headphones have many uses. But chief among them is to enable the magic of music. That magic comes in two main varieties:

1. Energy

In Fig. 1 the photographer captures a moment at a live concert. We do not expect that the singer has livid orange-pink skin, nor that the guitarist actually had pale purple hair. I might use image editing effects to make my own "enhancements" as dictated by a momentary whim:

Fig. 1: Queensrÿche live at Metal Heart Festival 2007, (Photo by GoogleMe, Wikipedia Commons)

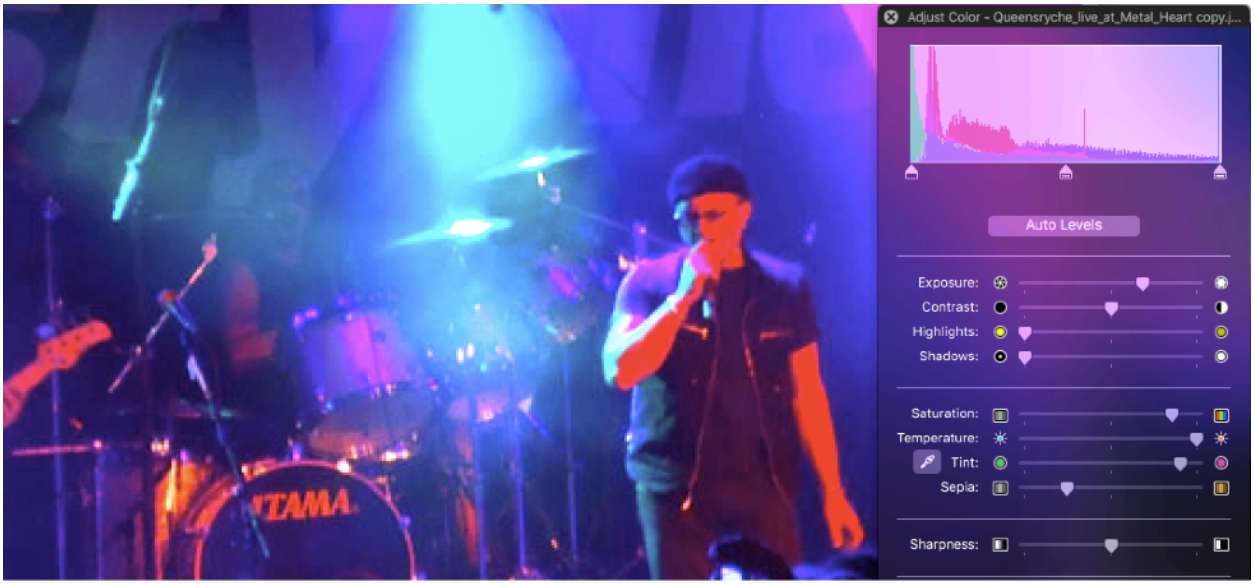

Fig. 2: modified version of Fig. 1

Here I've jacked up brightness (Exposure), colour vividness (Saturation), colour temperature, and tint to arbitrarily high values. The result hardly seems an insult to the aesthetic intent of the stage manager of that concert.

If the majority of your focus is on the music magic of raw power, I don't know that you'll get much benefit from digging into the units after the first three. Instead, I'd recommend a more hands-on approach. Watch some YouTube headphone reviews, ask some questions on a headphone forum, then buy the headphone with the particular sonic flavour you think you'll enjoy. That may be bass cannon, optionally with relaxed upper mids, or it may be what's called a fun or v-shaped tuning that combines both boosted bass *and* boosted highs, or anything else.

2. Art

Now let's try a different picture:

Fig. 3: Edward Burne-Jones, The Love Song (1868-77) (source: Wikipedia Commons)

If you're ever at the Metropolitan Museum in New York City, you might be lucky enough to catch this exquisite Pre-Raphaelite painting on display. Let's zoom in and "enhance" one section of it:

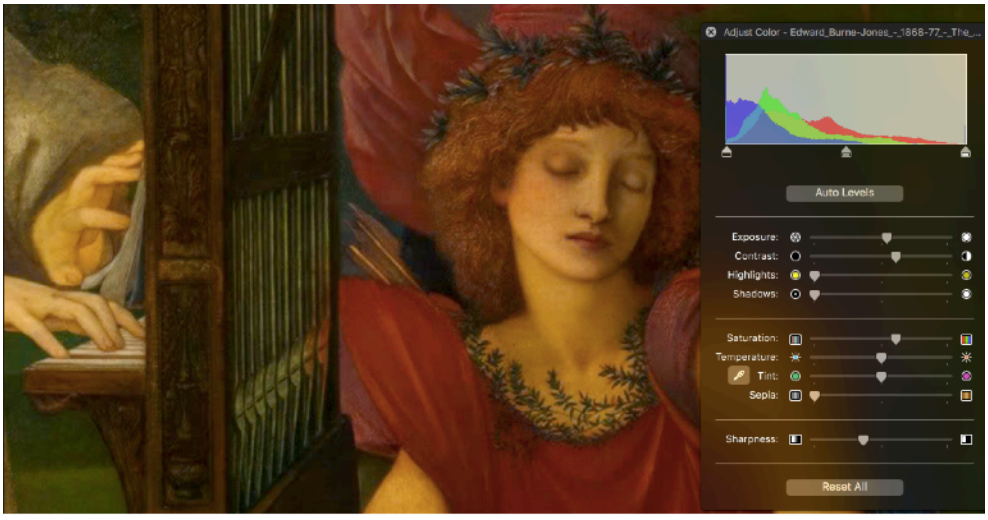

Fig. 4: modified detail from Fig. 3

For Fig. 4 I brightened, increased light/dark contrast, added saturation and blurred by a moderate amount. These changes are typical of what's routinely done to create instant grab visuals.

But the Metropolitan did not pay millions of dollars for the “enhanced” version of this painting. The artist at the peak of his craft did not see fit to goose up colour and contrast, although he could easily have done so. Nor did he likely wish it to be viewed framed behind a smudged and hazy piece of glass (blurring). The particular degree of brightness, contrast, saturation and sharpness the artist employed work together to create the atmosphere/ambience he intended as being appropriate for the subject matter and emotional intent of the picture.

The audio equivalent of Fig. 3 is what the five frequency response units of the Headphone Essentials series are aimed at. When the music magic is of the beauty, rather than the beast, variety, we assume the artistry contained in the recording is just what the artist(s) want us hear. No further adornment needed.

In today’s electronic music playback technology the headphone or room loudspeakers are typically and by a huge margin the most compromised element in the signal chain. You can pay a good money for an amplifier and DAC rated for 0.0001% distortion, you can use a lossless 32/192 FLAC copy of the best engineered recording of a particular track available. But a typical headphone introduces 5, 10, 20 and higher percent signal deviation in various portions of the frequency response. The kind of distortion that amp and DAC enthusiasts obsess over is called total harmonic distortion plus noise. THD+N has only a veering relation to the gross frequency deviations a headphone (or room loudspeaker) introduces to an audio playback system.

To most enthusiasts this gross signal deviation is just a personal taste issue, like preferring dark roast to light roast. But it’s more than that. Any time a frequency band is louder compared to the other bands, you’re leaving detail and clarity on the table — detail that’s on the quiet edge of audibility in comparatively recessed portions of the signal. By all means enjoy any colouration you like. But sanity says you’re throwing money down the drain when you buy expensive equipment then throw away the very nuances that equipment is supposed to reveal. Yet there are few headphones indeed that are close to accurately tuned.

To me, the solution is to buy that headphone in your price range that has the best qualities in all other areas, comes fairly close in tuning, then use EQ if needed to correct its remaining tuning deficiencies. The prejudice against EQ is slowly on the wane, but there is still a lot of mis-information out there promulgated by hardware-only purists for whom an inaccurate signal is somehow preferable to an “impure” one.

Help! I just want to know what headphone to buy!

I feel your pain — if only life were that simple. Is there a best motor vehicle purchase? Or do we at least need to know whether the use case is multi-passenger in-city plus highway vs all-terrain vs utility vs long-haul freight? Is there a best casual street shoe? Or is fit and comfort far too personal a thing? Headphones are just too diverse.

There are over-ear, on-ear, and in-ear headphones. Wired and wireless (optionally plus noise-cancelling). There are closed-back and open-backs. If, for example, your use case is for commute, noisy environments and/or preventing sound leakage from the headphone, you need an in-ear or a closed-back over-ear with as much passive sealing as possible and optionally noise-cancelling.

People’s needs and preferences are just too varied for blanket recommendations. The whole point of the energy vs art dichotomy above was to make just one of the major personal preference differences clear. Worse yet, the internet overflows with reviewers who hype and pan products as if their own tastes and biases were shared by every rational person on earth. There’s no escape: research and skepticism are both essential for headphone shopping.

I am definitely in the art, not the energy, camp and so am focused on accurate playback. Here are some well-measuring budget-priced, wired headphones that don't require added amplification. I haven't heard any of these, but based on available information I would research for suitability to my needs (prices are US dollars list as I write this):

Superlux 668B	$34	over-ear	semi-closed	moderate extra bass
AKG K361	$85	over-ear	closed-back	extra bass
Audio-Technica M40x	$100	over-ear	closed-back	moderate extra bass
AKG K371	$120	over-ear	closed-back	extra bass
Philips X2HR	$145	over-ear	open-back	moderate extra bass
Beats Solo Pro	$199	on-ear	closed-back	extra bass
Sennheiser HD560S	$200	over-ear	open-back	neutral/accurate

But if you can handle a greater cash outlay, the Sennheiser HD 600 ($400 list), HD 650 ($400 list) or its clone the Drop+Sennheiser HD 6XX ($200) are outstanding choices for neutral/accurate open-backs. Buy used for greater savings if you have a trusted source.

$200 to $300 for something like the HD 6-series is as expensive as I would recommend anyone go for a inexperienced headphone purchase under most circumstances. More expensive, "audiophile" headphones certainly exist. But these are specialized hobbyist/enthusiast products that require separate electronics for digital conversion (DAC) and amplification to produce their intended sound quality benefits. More on the perils of the deep end of the price pool in the footnote section below.

However, if you do have the extra money, here are a few well-regarded headphones in the next price tier to research, taken from this more extensive list:

Audio-Technica R70x	$350	over-ear	open-back	neutral/accurate
Hifiman Sundara	$350	over-ear	open-back	neutral/accurate
beyerdynamic DT1990	$600	over-ear	open-back	neutral + mod. bass
Drop+Focal Elex	$700	over-ear	open-back	neutral/accurate

Hifiman as a company used to have a long-standing reputation for built and reliability issues. They seem to finally be getting past that and do seem to be responsive to warranty claims. Plus, the Sundara is a recent model that seems to be fairing well. As the only planar magnetic model in either list the Sundara is intriguing. Again, at this level it's pretty much a waste of money to run any of these straight out of a smartphone or computer. You need to spend at least a comparable sum of money on amplifier and DAC in order to actually hear anything like their potentially superior sound quality. Apparently, this is especially true for the R70x and the Sundara.

Finally, here's what little i can tell you based on actual personal experience:

Audio-Technica ATH-M50x: $150, closed-back. I use the M50x when I need some sound isolation in a noisy environment. It helps to reduce outside noise, but by no means eliminates it. It's audio quality is acceptable to me without EQ, given that it's competing with environment noise. Both the extra bass and the extra highs provide added clarity. It has a very close-to-your-head sound stage. But its great weakness is comfort. It's clamp force can be reduced by stretching the headband, but the small, shallow ear pads are less than ideal.

Sennheiser HD 579: $170 discontinued, open-back. Comfortable, with a decent but non-luxurious build quality, proven over more than a decade of HD 5-series headphones to be reliable. I find the skewed mid-range response of the HD 579 make it almost unusable for accurate playback of music, depending on the track. But applying an appropriate EQ correction transforms it into quite a good performer at $75 or less. This should also apply to the other models in Sennheiser's HD 5-series.

Sennheiser HD 600: $400, open-back. Already discussed above. I got the HD 600 used from a trusted source for about $250. This is a headphone I use without EQ when necessary, but prefer using EQ to reduce its (admittedly slight) elevation in the bass-to-mids transition area. That said, many actually prefer that particular colouration. They do have a small sound stage presentation, but the sound source placement in that stage is very good.

beyerdynamic DT 1990 Pro: $600, open-back. Premium, faultless build quality. A minority of people find that the high frequency spike of the DT 1990 renders it unlistenable. I don't have that sensitivity and have yet to find anyone who does. It comes with two sets of ear pads, providing a greater bass boost and a more moderate bass boost. What bothers me, like with the HD 600, is the elevated bass-to-mids transition even with the less boosted ear pads. Other than that it has an excellently tight, clean sound that works well with relatively modest electronics.

You'll find a deeper dive into the above four headphones on my web site in the section below the Headphone Essentials series.

Footnote: You don't need a Cadillac

Headphones exist at all prices from freebies that come with a playback device to the +$50,000 Sennheiser HE-1 and Hifiman Shangri-La. For many people — particularly males — headphones and their support electronics can easily shift from being a near-commodity purchase to becoming a hobby or even an obsession. I find the theory that this is hard-wired into our brains quite convincing:

For the past million years proto-humans have left a trail of handcrafted stone tools scattered over the landscape. Hordes of such tools clearly made with painstaking effort have been found. In the 19th century European males were obsessed with horse-riding tackle. Hand-crafted reins, saddles, etc. that differed in ways we can now hardly distinguish sold for the equivalent of thousands of dollars where something a tenth that price was already of more than excellent utility. And then there followed the invention of the automobile and inevitably, the luxury automobile, from Rolls Royce to Lamborghini. In short: we have an in-bred addictive disease we call Gear Acquisition Syndrome, which can lead to some pretty significantly self-destructive spending.

In this century in the headphone space, Beats invented the fashion headphone, sparking an industry with some real money involved. The luxury headphone actually preceded that in the rarified audiophile space. But now the number of headphone enthusiasts has multiplied to the point that mammoth headphone product showcase events are common place. If your budget can reasonably extend to a $100 headphone, you nevertheless quickly become aware that $200, $500, $1000 and up options exist. How to be satisfied with a mere $100 item when clearly it must at best be only barely adequate? Of course, if you have free time and free dollars to burn, the headphone hobby is as good a money sink as any, and arguably better than quite a few others as an environmental impactor. (That headphones are routinely re-cycled on the used market helps considerably.)

But if you don't have money to waste and you genuinely enjoy quality music playback, how do you navigate this maze? Retired headphone reviewer Metal571 once quipped that his greatest regret was that he didn't stop when he acquired the Sennheiser HD 650, also available from Drop for $200 as the HD 6XX and similar to the HD 600 I recommend above. This is great wisdom. Most headphone enthusiasts would probably rate the HD 650 as being a good, if unexciting, low mid-fi product. My experience is with the HD 600 model. Even plugged straight into my smartphone what I'm hearing is very much of a piece with my memory of many a live acoustic music concert in a quality auditorium. Plugged into my modest amp+DAC device I'm hearing detail and nuance I'd expect from premium concert seating. And that's from a total $500 expenditure.

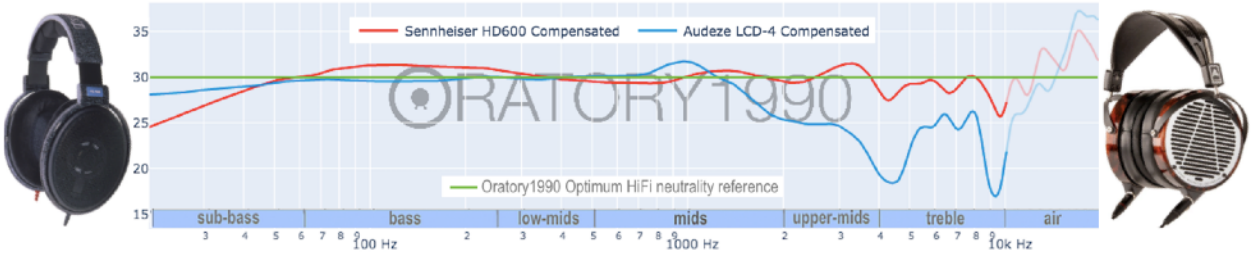

Fig. 5: HD 600 vs LCD-4 (source: Oratory Grapher)

The graph in Fig. 5 may look meaningless but is easily explained. Bass through treble pitch runs left to right; loudness runs up and down. The green line is the flat response of accurate playback. The red and blue lines are the measurements of two headphones: the Sennheiser HD 600 costing $400 list and the Audeze LCD-4 listing at ten times that amount.

Yes, the HD 600 has a noticeable dip at the far left, but few instruments and no voices actually sound in that range. The LCD-4, while admirably close to flat through much of the range takes a massive dip starting in the middle mid-range and not returning to flat until the very edge of human hearing on the right. This is exactly equivalent to having the bass and mid-range frequencies of every instrument and voice close to the listener — and the high frequencies much further away. Yet it's from those very high frequencies that we get the clarity edge to sounds that makes them so much easier to distinguish.

Yet this is not an exception, but is more the rule. A typical multi-kilobuck headphone has one or more serious weaknesses in its acoustic performance. Designers are optimizing for some very specific audio qualities — such as degree of separation of the instruments and voices in a recording — at the expense of something as fundamental as a consistent level of loudness from bass to treble.

And even one of the rare problem-free high-end headphones like the Focal Utopia is reproducing details in the recording that the musicians that performed the music are unlikely to have heard or even wanted to hear, such as the spittle in a singer's voice or the separate rasps of each horsehair in a cellist's bow. And to get that level of performance you need to add another $4000 for equivalent electronics to support the initial $4000 of the headphone itself. Now you need a library of those rare ultra-high quality, noise-free recordings to listen to. (Ready for a deep dive into FLAC vs MQA vs CD?) For most recordings you're simply hearing their faults amplified to an exquisite level of annoying clarity.

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So overall, the purpose of the Headphone Essentials series is to provide factual information in the areas I have some competence in to aid in headphone pre-purchase research and post-purchase utilization and enjoyment. Enjoy!

Back to the Headphone Essentials series. You've been warned, grin.