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SOUND IMPROVEMENT – REAL, IMAGINED, OR FRAUD?

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When customers purchase audio equipment for better sound, what are they really buying? I contend it is mainly small changes in frequency response. In my first recording I pointed out how sensitive your ear is to small changes in frequency response – much more sensitive than most engineers think. My second recording dealt with the importance of frequency response. It pointed out that the frequency response characteristic of your system and any of its components is *the* most important characteristic that affects your perception of the sound.

If you are listening to music that has poor tonal balance, it may be hard to hear a 2 dB (decibel) difference in frequency response. If it's tonal balance is nearly perfect, as little as 1/10 of a dB is perceptible and becomes quite important. I believe a lot of equipment is sold because it is making differences in frequency response in tenths of a dB.

POWER OF EXPECTATION.

Lately there has been considerable discussion as to whether high-end audio is a fraud. For example, in the Audiophile Group in LinkedIn, that is the title of an active discussion. Many of the member's comments are to the effect that there is considerable fraud in that business. My take is that the audio business is a combination of real sound improvements, imagined improvements, and some of it is outright fraud.

I think what keeps companies that make audio products that do nothing for the sound from going out of business is the power of expectation. Your ears hear what you expect to hear, even when the benefit is just imagined. People expect higher priced equipment to sound better. Buy it. Try it at home. Return it if you are not happy with the performance. Expectation makes it sound better, especially when you are unable to make a quick blind comparison against an alternative.

I hate to admit it, but even I have been deceived by expectation. For many years I used a hand-held tone control prototype of my own design. This device was never produced, but became the predecessor of the Cello Audio Palette. It had 6 tone controls working in different parts of the audio frequency range. Instead of using expensive, custom made, two-gang, 60-position switches with 120 1% resistors for each 2-channel tone control, my prototype used a cheap pair of 3-inch linear potentiometer sliders for the left and right channels. Two fingers operated one closely spaced pair of sliders.

One day I was standing up, intently listening to my sound system while operating the tone sliders at waist level. Having spent much of my life designing tone controls and feedback systems, I knew exactly how each control sounded when boosting or attenuating. As I carefully moved the sliders to refine the sound of the music, I clearly heard the improvement in sound and left the sliders at my preferred position. When I looked down, I discovered the tone controls were actually switched out. I had done nothing. My self-deception did not happen just once, but perhaps 2 or 3 times a year during a period of 10 years.

I remember visiting a leading audio manufacturer many years ago. Their chief circuit designer came into the room raving about how much better his new op-amp design using discrete parts sounded vs. the integrated circuit op-amp he used yesterday. I was sure it was his imagination. My home sound system, mostly of my own design, used nearly 2000 integrated circuit op-amps, and I was able to switch in or out, all at once, a series of as many as 20 op-amps without hearing any difference in sound.

A trusted audiophile friend told me he heard an improvement in sound due to replacing one Home Depot power chord with a different Home Depot power chord. My engineering training and experience said this was impossible if the chords and his amplifier worked properly. Perhaps he moved a piece of furniture and slightly altered the frequency response at his listening position. Due to the extreme sensitivity of your ears to frequency response, that might be audible. Or he could not accurately remember the sound of the first chord due to the time it took to make the change.

In high-end audio there is a lot of discussion regarding burning-in speakers, power amplifiers, and other equipment. I think what really changes is the perception of the owner who cannot exactly remember the initial sound over a long period of time.

SPEAKERS

There are huge variations in frequency response from one speaker model to another. What is most important about a speaker is that the frequency response should be smooth. Then it can be equalized for good balance and really enjoyable sound. It is easier to achieve smooth frequency response from a small speaker than a big speaker. Some manufacturers sell big speakers priced at hundreds of thousands of dollars. Are they worth it? While the law of diminishing returns applies, generally as you spend more money, you may be getting a little better frequency response, while the cost of parts in a very expensive speaker is a lot more than in a cheap speaker. The parts cost may be a only a small part of the high price because the manufacturer decided to sell only a few units as flagship items and try to recoup its high engineering cost on those few units.

Your ears are very sensitive to left-right balance. If your room is not symmetrically built around your speakers, they may need a gain difference of 0.1 dB, 0.2 dB, or more. Also it is very difficult to manufacture left and right speakers that match closer than +/- 0.5 dB due to mechanical tolerances. A left-right gain difference of 0.5 dB can make a substantial difference in the sound character of various musical instruments. The same speaker may sound quite different in two different rooms

POWER AMPLIFIERS

Aside from their power output capability the main differences in sound between one amplifier and another, I contend, are small differences in frequency response which result primarily from the internal output impedance of the amplifier.

There are two groups of amplifiers. The first incorporates a lot of feedback and they all tend to sound almost identical except for their clipping levels. The second includes mostly vacuum tube amplifiers with low to moderate amounts of feedback and these all sound a little different primarily because of differing amounts of feedback. An amplifier that has only a small amount of feedback presents a higher internal source resistance, and when the load is connected, the output voltage drops. At the primary resonant frequency of a speaker where its impedance rises, for example around 50 Hz, there is reduced loss and output voltage increases. This bass boost may give a particular amplifier-speaker combination pleasant warmth. Similarly the amplifier may enhance or degrade the frequency response at a speaker crossover frequency where the load impedance changes.

Certainly that is not the best way to get good bass. You can get lower, more solid bass using an equalizer. Modern active subwoofers in small boxes with powerful amplifiers can produce better frequency response to lower frequencies because the amplifier is equalized to compensate the speaker. As a lifetime circuit designer, I have designed many vacuum tube amplifiers, semiconductor amplifiers, and switching power amplifiers and know how each of them work, how they sound, and how each is affected by connecting wires. In 1952 I designed the lowest distortion vacuum tube amplifier ever made, The Krohn-Hite Corp Model UF101. It had 50 dB of feedack and was manufactured in small quantities for 20 years as a laboratory test instrument. This amplifier was rated at 0.005% total harmonic distortion. Its high feedback made it sound exactly the same as modern QSC public address amplifiers, 17 of which I use in my home audio system. The QSC amplifiers are made with transistors and a lot of feedback. Each QSC amplifier delivers more power with far lower distortion than a modern vacuum tube amplifier and costs a lot less.

Musicians still use tube amplifiers for their guitars because the more gradual overload characteristic provides a pleasing sustain. That is no reason to use tubes for reproducing music at home. Power tubes wear out long before transistors and need scheduled replacement. Today I would not accept a vacuum tube power amplifier or preamplifier as a gift. Think of an expensive tube amplifier as a nice piece of furniture that glows in the dark.

EXPENSIVE CABLES

What do expensive cables do for the sound of your audio system? In my knowledge and experience - nothing. They waste your money. Many are sold based on deliberately misleading measurements or bad science. Often the claimed effects occur only at frequencies beyond audibility, and that is not mentioned.

In the case of speaker cables, there can be small differences in sound among types because of slight changes in frequency response amounting to a fraction of a dB. The main differences are due to signal losses caused by the resistance and inductance of the cable. Speaker impedances are so low, the small capacitance of any cable does not matter within the audible frequency range. Resistance is determined by the gauge and length of the

cable and is the same for both cheap and expensive cables of the same gauge and metal, generally copper. Silver has only 5% lower resistance. If you want reduced loss use a heavier gauge.

Inductance is determined primarily by the length of the cable and is somewhat affected by the conductor spacing, stranding, twisting, and some other factors. Plating and construction affect the resistance to corrosion, diameter, and flexibility. Manufacturers of expensive cables offer a variety of proprietary constructions as an excuse for high prices. Cheap cables are also available in a smaller variety.

Interconnecting cables with RCA plugs may affect the frequency response at 20 kHz by 0.1 or 0.2 dB, completely negligible. Some extremely expensive cables add a molded box part way along the cable to increase its inductance, capacitance, or common mode impedance. Don't waste your money on them!

TWEAKS

Tweaks such as paint for your CDs or objects to place on top of speakers or equipment are a complete waste of your money. CD players, A/D, and D/A converters clean up normal digital signals and reclock them. There is no advantage in attempting to microscopically alter their inputs. Some of the explanations and terms like "artificial atoms" sound like a joke. They have no scientific basis, but they are duping people into becoming customers.

MAKE A REAL IMPROVEMENT

To make real improvement in your audio system, change its frequency response. If you do not want or cannot afford my BURWEN BOBCAT TONE BALANCER software, use someone else's tone controls or equalizer. There is a free equalizer accompanying the Windows Media Player included as part of Windows operating systems. Most sound drivers in new medium and higher priced computers include some sort of tone controls or equalizer.

Some audiophiles argue that equalization is bad because it introduces detrimental phase shift. That is absolutely wrong. My tests showed that much greater phase shift than produced by equalizers is barely detectable by ear under rare conditions, and does not degrade the sound. Furthermore, the mathematics of equalization shows that if equalization improves the frequency response of your system or program material or both, it introduces a corresponding phase shift that actually corrects existing phase distortion. Older analog equalizers may not have sounded perfectly transparent when they were set at flat due to tolerances in resistors and capacitors. New digital equalizers are mathematically accurate.

Another argument I have heard is that bad sound is caused by polarity reversal in recording, manufacturing, or playing CDs through your own system. Again, my own tests showed this to be a microscopic effect and not detrimental to music. If you can detect it at all, your listening room probably has too much sound absorbtion for best music reproduction.

SUMMARY

You can spend a lot of money needlessly on audio equipment. Frequency response is the most important characteristic of your audio system and its components in determining your

perception of its sound quality. Speakers are all different. If you spend more you may get better frequency response. Cost increases exponentially for incremental improvements. Get more for your money by purchasing a speaker system that has smooth response and equalize it.

Vacuum tube power amplifiers are expensive, fussy equalizers. Save money and trouble with high-feedback semiconductor amplifiers and use a real equalizer.

Expensive cables and tweaks are explained using bad science and really amount to fraud. It is possible some manufacturers actually believe in their fraudulent products through self-deception.

Imagination and the power of expectation cause people to deceive themselves. This has happened even to me. Blind comparison testing should be used as much as practical.

For best control of your system's frequency response get the BURWEN BOBCAT TONE BALANCER software which works with the Windows Media Player. Learn about the software and hear jazz and classical demonstrations at www.burwenbobcat.com. There are free equalizers available in the Windows Media Player and some computer sound drivers.