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Comparing the Cost of Preamplifiers to Their Sonic Fidelity and Frequency Output

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More than ever, too many times, audio engineers get caught up in the hype of big name brands and large price tags. However, the popularity of a brand, as well as the cost of its gear does not always equate to quality hardware. The microphone preamplifier is a perfect example of this disparity between price tags and brand names and performance of the equipment. The goal of this paper is to make one second guess the intrinsic idea that things that cost more and have a solid brand reputation actually sound better. I will support much of my proposal with findings from *Sound on Sound*'s 2012 study implementing a microphone preamplifier shoot-out. In supplement, findings from my own preamplifier comparison will be offered.

Before I jump into my research and findings on the preamplifier comparison to price and name reputability I would like to describe how a preamplifier works in layman's terms. A preamplifier is necessary to amplify a sound signal that would otherwise be too weak. It reads signals of sound, temperature, light, movement and more from sensors and other parts and consequently colors the sound and changes the tone subtly through differences in impedance ("Audio Mic Phono Stereo Tube Bass Guitar Signal Preamp Pre Amp Preamps Preamplifier").

The origin of the preamplifier is an interesting one. David Hafler is known for being the man in charge of sparking widespread attention to the importance of a preamplifier. In 1950, Hafler, along with Herb Keroes, began Acrosound, which was a company with the intention of making output transformers, primarily for home electronics hobbyists. After only a few years, Hafler and Keroes took different paths. Subsequently, Hafler met an audio engineer by the name of Ed Laurent, who is responsible for making his own kind of single-tube driver circuit for a power amplifier. Thus, in 1955, Dyna Company saw its genesis, and their main goal was to produce transformers and high-quality audio circuitry ("History – Legacy of David Hafler" 1).

The first product that Hafler and Laurent sold was the Mk. II 50 watt power amplifier. Dynaco's most famous piece of audio gear is the ST-70, a high quality power audio amplifier offered to the public in exchange for a reasonable expense. As of today, the ST-70 has been purchased over 350,000 times, making it the most popular tube power amplifier of all time. Currently, it can be found being sold on eBay for a minimum cost of $500. Although most of the tubes are burnt out on the eBay ST-70s, new, replacement tubes can be bought for a mere $50 ("Hafler+st-70 " 1). The fact that one can pay less than $1,000 and reinstate a piece of high quality audio gear from over five decades ago is outrageous ("History – Legacy of David Hafler" 1).

The preamplifier was invented by Hafler, and his accompanying patent was filed in 1958. It is surprisingly interesting that the preamplifier has only been around for about half a century. I would have assumed that it has been around for well over a century. In any case, the objective of Hafler's necessary invention was to "provide an amplifier for amplifying voice or music signals or any other sounds or noises in the audio frequency range, -between sub-audible and super-

audible or supersonic frequencies, without distortion and with true delity (*sic*)" ("Patent US3059190 - Pre-amplifier").

Unsurprisingly, Hafler still has his own line of audio engineering gear, and more specifically, preamplifiers. Current products in the Hafler catalog include headphone amplifiers, phono stages and power amplifiers. The products are simple in cosmetic design, but are revered as sturdy, dependable pieces of hardware.

The Hafler PH50 is a particularly interesting piece of hardware from the Hafler product line. It is a "high-performance phono stage for moving magnet (dynamic) cartridges that incorporates a well define RIAA curve to preserve and transmit the original program material with minimal coloration." This phono stage features a low cut button that will reduce rumble from the audio. A specific, pertinent purpose of this machine is to reduce noise, which results in a -82 decibel noise floor, 91 dB of dynamic range and less than .002% distortion. The 14-gauge steel casing protects the low level signals from external magnetic fields and radio frequency contamination. Gold-plated RCA connector pairs ensure the absence of tarnishing, which allows for an optimized signal flow. Each part on the solid-state circuit and PC board has been intelligently positioned to create minimal self-noise and cross-talk (PH50 1).

There is more to boast of the Hafler PH50, as if it wasn't already sounding like an incredibly crafted, professional sound machine. The fully adjustable low cut filter eliminates "airborne and solidly coupled" transmission of vibrations that can interfere with the stylus and cause feedback and distortion. The PH50 employs minimalism design by featuring only three

buttons on the front panel. On the back panel, there are simply Left and Right inputs and outputs as well as a 15V DC input. Lastly, there is a ground spade connector (PH50).

Luckily, a colleague of mine, Chris Thomas, relayed the article and experiment from *Sound on Sound* to me about a week ago, and it instantly gave me hope that I could afford professional sounding gear. My belief that expensive is better was disillusioned after Chris pitched to me the ideas and findings of the comparison, because I previously simply thought that the more you spend, the higher quality product you will receive. Sam Inglis' comparison of preamplifiers in *Sound on Sound* is strikingly similar to the microphone shoot-outs we performed in previous audio production classes.

The idea that if you pay more, then you will get more is swallowed up too quickly by too many. This belief effectively wastes people's money while providing them with equipment that is not superior to the more cost-effective gear. I have fallen victim to this trap too many times myself due to my inexperience and ignorance regarding the quality and performance of audio engineering equipment. Also, many times I have seen an artist or engineer that I look up to using a particular instrument or piece of gear, and I immediately wanted to purchase said equipment so I can produce the same quality that my idols put out. When people hear the word "Neumann," they think quality microphones. When people hear "Avid," they think superior, industry-leading digital audio workstation. While these two previous statements are usually true, it is not a definite truth throughout the musical gear marketplace.

The term "good preamplifier" is completely subjective, because different people enjoy different sounds and effects. For the genre I work with most, hip hop, I enjoy heavy low-end,

mids that cut the vocals through and a slightly shelf-boosted high-end to give the vocals presence. For jazz or country, one might want a totally different sound. However, this comparison of preamplifiers has shaken my previous belief that they make a difference in the sound at all.

Although the highest priced gear doesn't always provide the most sophisticated output, high-profile companies and their pricey gear are still of value. There are upsides to spending that extra cash to purchase the "luxury" musical hardware, such as brand notoriety attracting potential clients, better warranties and customer service, and possibly the life of the product.

Sound on Sound's microphone preamplifier shoot-out was conducted using a Yamaha Disklavier, The Disklavier is a rare grand piano with a discreet MIDI sound module below the left side of the keyboard. The piano is fitted with electronic sensors for recording and electromechanical solenoids for playback. Sensors keep track of the movement of the keys, hammers and pedals during performance. The MIDI sound module saves the performance data as a Standard MIDI file. During playback, the solenoids control the keys and pedals, therefore reproducing the original performance (Litterst 1). This gives the study continuity across various preamplifiers, because the Disklavier will play virtually the exact same melody or phrase again and again. Because the piano has a wide dynamic and frequency range as well as fast transients, it is a very revealing instrument and therefore perfect for this test that relies so much on detail and exactness (Inglis 1).

Although I referred to this study as a shoot-out, Inglis makes it clear that it is a not a competition, but rather a comparison. The preamplifiers put to the "test" were the Neve 1073LB module, 1U 3124+ unit (with four API preamps), four-channel SSL XLogic VHD preamp, Maselec MMA-4XR, GP Electronics PML 200E, Sonic8's ART Pro MPA II and a Mackie 1402 VLZ Pro. The sound from the piano was recorded at 24-bit, 44.1 kHz, and Inglis used Logic as the DAW.

Sound on Sound's crew used a pair of Brauner tube microphones, a Royer SF12 (stereo ribbon mic), and a collection of Sennheiser MKH small-diaphragm mics in order to test each preamplifier with three different microphone set-ups. Obviously the crew made sure all the sound levels were as similar as possible to give a similar reading across the board (Inglis).

Initially, members of the *Sound on Sound* crew swore they could hear great differences between the preamplifiers. They all enjoyed the warmth from the PML 200E; the ART sounded like it was straining; the Maselec impressed by sounding "accurate yet musical" and so on (Inglis). These conclusions were made after listening to the sound samples while knowing which preamplifier was being used. This means that all of their preconceptions and notions that they had going into this comparison influenced their reactions to the sounds. Therefore, if one is partial to Neve, they will most likely claim the Neve sounds good whether or not it sounds better or worse. Also, if a certain preamplifier has a big price tag, one might say its results are better than they actually are.

Subsequently, the author and curator of the comparison, Inglis, decided to anonymize the playback so the listeners didn't know which preamplifier was creating which sound. This is

when very little differences were heard, and they could barely distinguish between pricey preamplifiers and the more cost-effective ones. Inglis does not go any further describing these results, because he wants the reader to listen to the sound files and make up their own mind as to which preamplifier sounds best. Inglis emphasizes the fact that the reader should do their own listening to the different preamps and make up their own mind regarding how each sounds, instead of just telling the reader which preamp is best right off the bat.

For listening to these Disklavier recordings (link to download audio files: http://www.soundonsound.com/sos/oct12/articles/preampsmedia.htm), I am using two KRK Rokit 5 monitors through a Presonus Audiobox USB into Presonus Studio One (Inglis – Media). I will be listening to the three different microphone set-ups for each of the eight preamplifiers and describing their sound output, and also which one I think sounds best, as well as worst. Again, the preamplifiers are anonymized, so I do not know which preamplifier I am listening to. The piano piece played by the Disklavier is a slightly dissonant jazzy melody that lasts just over a minute.

First up is the set of melodies recorded using two Brauners positioned as "spaced pairs" about 18 inches above the soundboard. After listening through all eight of the melodies from different preamplifiers, I am overwhelmingly surprised by how little the differences are between each melody. I was trying my best to pinpoint certain, unique qualities each melody had, but they were all simply too similar. One or two seemed to be slightly lacking in frequency range and one didn't sound too exciting, but other than that they were all strikingly similar. The one that struck my fancy the most would have to be "Brauner_A" because it exuded all the emotions I believe this piece should give out. I also enjoyed the dynamic range of this take. There wasn't

really one that stood out as particularly bad sounding; they were all solid recordings. However, the skeptic in me thinks that my opinions of these pieces might be primarily based on how I was feeling while listening to them and not actually how the melodies sounded. Basically, I wouldn't be able to tell you the difference between a $150 Mackie VLZ Pro and a $3000 API mic pre.

I don't think I can blame this lack of sonic differentiation on my KRK monitors, because they seem to be very straightforward, yet detailed monitors. However, it would be nice to hear what these audio files sound like on our school's JBL monitors or something of that scale.

After listening to the Brauner Microphone set-up takes, I moved on to the Sennheiser MKH small-diaphragm capacitor microphones. These were positioned similarly to the Brauner stereo pair set-up. Something tells me that I might enjoy these takes the most merely because I own Sennheiser products and therefore am biased to them. After listening to all the MKH takes, I couldn't find much different sonically about each one, let alone pick the best and worst ones. It seems as if the lines have blurred even more that separate quality and lacking takes. I am still baffled that a microphone preamplifier that costs the same as a used car produces virtually the same sound as a $150 Mackie mixer.

Lastly, it was time to listen to and compare the takes using the Royer SF 12, which is a ribbon microphone. Going into listening to these takes, I believe the pattern of similar sounding melodies will continue. A different microphone set-up might change the overall sound of all eight takes, but it should not however create differences between each take within this set. After listening to the Royer "auditions" of each preamplifier, I am fairly convinced that the cost of a

preamplifier doesn't represent its quality or competence. I was actually listening intently and trying to pay close attention to detail, but each of the eight pieces sounded nearly identical.

David Meller, from the website *Audio Master Class*, mentions a similar study to *Sound on Sound*'s. In January of 2012, visitors to Record-Producer.com were asked to listen to sample recordings and distinguish which recording used the most expensive preamplifier and which one used the cheapest. The preamplifier that the most people believed to be the most expensive was actually the Texas Instruments INA217, which is a $5 preamp. The preamplifier that came in second place was the Universal Audio LA-610 Classic Tube Recording Channel which is a $1500 preamp (Meller 1). These findings are ironic as I usually hear that Behringer products are not the most reputable, because of their inconsistency in quality across a wide range of gear.

This information makes me want to learn a whole lot more about psychoacoustics and why we hear the things we do. I believe our hearing is based on emotion, expectation and a number of other factors – not merely the sounds that enter our eardrums.

I have been using a $100 Presonus Audiobox USB for the last five years or so and have gotten very good results with it so far. Last semester, I recorded with the school's Shure SM7B through a Neve preamp and I could tell there is a distinguishable amount of quality between my Audiobox USB and the Neve preamp. However, I'd say the Neve only sounded about 10% better than my Audiobox USB. Mind you that my hearing isn't as fine-tuned as a professional audio engineer's, but the difference in quality pales in comparison to the difference in price.

One must also keep in mind that listeners involved in these studies and comparisons might not have the best ears or be the most competent audio engineers, especially those from the Audio Master Class website study. I believe that to truly achieve credible results, one would have to enlist the best audio engineers and hearing experts in the world to listen to multiple takes from at least 10 to 15 preamplifiers.

An old saying goes something like, "It's not the tools, it's the craftsman." This age-old adage couldn't ring truer while I was listening to the preamp comparisons. If all of these preamplifiers are giving out virtually an identical signal, then low-budget and high-budget studios alike have a comparable means to produce professional, quality music. Obviously, a mic preamplifier is not the only piece of hardware or software necessary to record, mix and master music, but it is a key component that many people assume has to be a pricey investment. A cheap preamplifier can be utilized creatively and innovatively to sound just as good as or better than an expensive one. The same goes for the opposite of this statement.

On the *TopTenReviews* website, they have a list of the top 10 best preamplifiers. Although it's difficult to tell how credible this website is, they offer a fairly comprehensive list, with information about each product. Out of the 10 preamplifiers, the cheapest one is a decently sized dent out of most people's wallet at $900. The average price of the 10 best preamplifiers listed is more in the range of $2000-$3000 ("Audio Mic Phono Stereo Tube Bass Guitar Signal Preamp Pre Amp Preamps Preamplifier"). Assuming my ears are hearing sounds correctly listening to the *Sound on Sound* comparison, then a $150 preamplifier sounds almost identical to a $3000 preamplifier, and the cost of the device has almost no pertinence to its quality.

However, one must keep in mind that this comparison was done using only the piano and in one specific environment and should be tested out more extensively to cement this claim.

To conclude discussion of the *Sound on Sound* research, the brand as well as price of a microphone preamplifier is of seemingly little relevance in relationship to its quality. In the *Sound on Sound* comparison, audio engineers noted good traits about sound that was recorded with reputable preamplifiers, but that is largely because of their bias and preconceptions of these brands. When listening to the same sources without knowing which preamplifier was being used, they couldn't tell the difference between a $150 Mackie device and a $3000 Neve preamp. I believe there is still much more to be put to the test to really set in stone my findings, however the information I have gathered so far is rather convincing.

As I have now decided that this topic of the lack of relationship between the cost of preamplifiers and their quality must involve further research and experimentation, I conducted a comparison of my own using CSUMB's preamplifiers as well as my own.

Before explaining the preamplifier shoot-out and its consequent results, I would like to specifically describe the kinds of preamplifiers used. This is to serve the purpose of seeing how the pieces of gear stack up to each other on paper and to quantitatively define their characteristics.

The first preamplifier we will look at is the API 3124+, which is a discrete four-channel preamplifier equipped with XLR, 1/4" and direct input capabilities. It uses the RE-115 K microphone input transformer, which is inside of every other API preamplifier as well. All of the microphone inputs supply power by an internal 48-volt phantom power supply.

Complementing this phantom power option is a 20-dB pad button that can be pressed to affect both the microphone and line input (API: 3124+ Mic Pre 1).

The 3124+ supports up to 65 dB of gain with an output clip level of 30 dBm (dBm is the power ratio of decibels referenced to one milliwatt). The front panel input goes straight to the op-amp, which allows it to amplify a quiet input without the need for a transformer or direct box. This input can raise a guitar, bass, keyboard or whatever one might plug in as high as +22 dB. The op-amps used are API 2520's. Located in the rear of the preamplifier is an XLR connector. The 3124+'s chassis comes in the form of a 19-inch rackmount. These specifications are impressive, however the price tag is a tad discouraging, coming in at $2715.75 (API: 3124+ Mic Pre 1). For a professional studio with a high-profile clientele and large budget, this is a small expense in the grand scheme of things. However, for the average home studio engineer, $3000 after tax and shipping is a not a reasonable figure.

Since the API 3124+ is the most expensive preamplifier in my shoot-out I think it would be helpful to include a specification list for the product.

3124+ Discrete 4-Channel Mic/Line Pre

Specifications	
Input Impedance:	1500 Ohms Mic, 470 K Ohms Un-Balanced, HI-Z in
Output Impedance:	Less than 75 Ohms Channel Outputs
Nominal Levels:	XLR Channel Output +4 dBu
Stereo Output Level:	Unbalanced: nominal -2, Balanced: +4
Clipping Level:	XLR Channel Output better than +28 dBm
Frequency Response:	+0, -5, 10 Hz to 20 kHz (-.5 at 10 Hz)
Noise EIN:	-129 Mic, -125 Un-Bal. Actual
Measured Noise:	Better than -91 dBm / below Nominal +4.
Distortion:	All Outputs at +4 out, .03%, at +22, .09% Max
Gain Range:	150 Ohms Input 10 dB Min., 65 dB Max (inc. PAD). Un-Bal. Input 14 dB Min., 50 dB Max
VU Meter:	Calibrated for XLR Outputs, OVU=+4 dBu, (-12, -6, -3, 0, +3, +6, +18)
Controls:	GAIN, PAD (20 dB), 48Volts, POL (polarity), MIC (mic/un-bal), VU, AC
Power Consumption, Quiescent:	19.2 Watts
Size:	19" X 1.75" (1U) X 11" Deep
Size (Boxed for Shipping):	23.25" X 6.5" X 16.5"
Actual Weight:	10.38 lbs.
Shipping Weight:	14.06 lbs.

Fig. 1 (API: 3124+ Mic Pre 1)

Another preamplifier tested in my shoot-out was my Presonus Audiobox USB. I have had this piece of gear for about five years, and it has given me nothing but surprisingly workable results. It features two simultaneously XLR and 1/4" inputs on the front panel, along with a 48V phantom power switch to control both inputs. Next, there are gain control knobs for each input and an indicator light for clipping. There is also a headphone monitor level knob, main level knob and a knob to control the ratio of input to playback heard in the headphones.

On the backside there is a USB port, a MIDI In and MIDI Out, Left Main Out, Right Main Out and a 1/4" headphone port. This piece of audio gear is lightweight yet sturdy, having survived several long falls to the floor. It has a frequency response of 20 Hz to 20 kHz with a deviation of +/-3 dB. The input impedance comes in at 1200 ohms. The gain control range, with a deviation of +/- 1 dB, is between 0 dB and 35 dB. The headphone output frequency response is between 20 Hz and 30 kHz, with a deviation of +/- 1 dB. The Presonus Audiobox USB records at a bit depth of 24 and can switch between 44.1 and 48 kHz internal sample frequencies (AudioBox USB | PreSonus 1).

For $99.95, before tax and shipping, the Presonus Audiobox USB is perfect for the amateur home studio engineer. The hardware also comes with an artist license for Presonus' DAW Studio One. I have been using this DAW for half a decade and I find it nearly equal to Pro Tools in terms of capability and ease-of-use.

Another preamplifier we will take a look at is the Rupert Neve Portico 5012. The Neve 5012 is a two-channel mic preamplifier, which features custom transformer designs. Something

that makes the 5012 stand out is the implementation of fully sweep-able high-pass filter. On the front panel is a phase invert button, gain knob, buss button, Silk button, trim knob, mute button and a high pass filter. The high pass filter is controllable from 20 Hz to 250 Hz (5012 Specifications 1).

One of the main goals during development of this piece of gear was to produce as little noise and non-harmonic distortion as possible. This is done by carefully designed signal paths and Class A amplification. Class A amplification is a fairly ancient technology that involves conduction of output throughout 360 degrees of a signal's waveform. This is different from other amplification systems that only conduct output for a half cycle or even less. Every Portico model uses input and output transformers, as well as almost completely discrete component amplifiers (5012 Specifications 1).

The Silk button is a unique feature that adds to the 5012's assortment of convenient features. It is supposed to augment sound quality while emulating vintage sound processing. The Silk button minimizes negative feedback and tweaks the frequency spectrum to achieve a charming recording. The Neve 5012's frequency response is -3 dB at 2.5 Hz and -3 dB at 125 kHz. There is a 40-ohm termination when gain is at unity. Noise is recorded at better than -10 dBu. The 5012 is 1.75 inches tall, 9.5 inches wide and 8 inches deep and it weighs 8 pounds (5012 Specifications 1).

The last preamplifier that I will be conducting the shoot-out comparison with is the Millenia STT-1 Origin. The STT-1 Origin is a single-channel channel strip that is comprised of a compressor, de-esser and parametric equalizers. This piece of gear is on the higher end of

expenses coming in at $3067.99 from online music equipment retailer Sweetwater.com ("Millennia STT-1 Origin."). The STT-1 Origin is unique in that it offers solid state as well as vacuum tube preamplification. This offers potential customers the choice of maintaining that classical tube amp sound or going with a more modern form of amplification. Also, the compression, equalization and de-essing can be done through either solid state or vacuum tube(Origin STT-1 Channel Strip 1).

The STT-1 origin offers a 1/4" vacuum tube direct input that can be routed through either the tube or solid state gain path. All of the audio connectors, tube sockets, relays and switches are gold-plated. The chassis is a military grade 16-gauge cold-rolled steel contraption. There is a toroid power supply in addition to an internal sub-chassis as well. The knobs are made out of hand machined aluminum and the push buttons are illuminated (Origin STT-1 Channel Strip 1).

The technical specifications are fairly standard in the world of audio preamplifiers. There is one channel with a frequency response of 5Hz-30kHz. Phantom power is at a voltage of positive 48. There are two XLR analog inputs and three XLR analog outputs. The unit is 3.5" tall by 15.5" deep by 19" wide with a total weight of 25 lbs. (Origin STT-1 Channel Strip 1). This thing looks like a complete, rugged machine on the outside and the internal specifications all check out as more than competent.

On paper, the Millennia STT-1 Origin seems like it should meet and surpass even the most demanding expectations from home and professional engineers alike. However, the real test is yet to come, which will involve listening to the exact same melody through multiple preamplifiers.

Now it is time for the fun part. The preamplifier shoot-out that I carried out on May 5th, 2016 involves the following pieces of gear: Neve 5012, API 3124+, Millennia STT-1 Origin (vacuum tube and solid state), Presonus Audiobox USB and Universal Audio's 1176 Compressor. I chose to directly input my iPhone and play the same song from 0 seconds to approximately 82 seconds. The reason direct input was my choice is because it is the cleanest way to replicate the same signal over and over again. The monitors I listened on are a pair of KRK's Rokit 5s, which is what I use regularly, as well as many other audio engineering professionals in the hip hop genre use. I will be using the original audio file of "Earned It" as the control, basically acting as the track that I want the preamplified tracks to replicate as best as possible while achieving the highest aural fidelity.

I chose "Earned It," by Canadian-based pop superstar The Weeknd, because his delicately intense high pitch vocals combined with the beautifully moving instrumentals make for a dynamic piece to capture. A huge component I am looking for is the fidelity of the upper range of his vocals, as well as the clarity and tone of the piano.

The first preamplifier "Earned It" was ran through is the Millennia STT-1 Origin using its vacuum tube. At first listen, the STT-1 Origin vacuum tube sounds strikingly similar to the original song. There is not an obvious coloration of any sort and wave shapes are seemingly highly similar. There is no audible hissing, rumbling, pop sounds nor fuzziness in this take. The Weeknd's airiness and presence is retained and simultaneously the bottom end frequencies from the kick and bass guitar appear identical.

After about 45 minutes of listening to the STT-1 Origin vacuum tube recording, I am pleased by its accurate replication of the original source file. There is seemingly no, or at the very least, coloration or lost amplitude in any frequencies from the piano. The piano is a crucial element to retain as it exhibits a wide range of tones and is one of the most delicate musical components of the track. Basically, it is the $200,000 porcelain vase hand-painted by Vincent Van Gogh in a busy room of items ranging from old leather sofas to antique credenzas.

I am surprised that the ST-1 Origin vacuum tube is doing so well, as it is utilizing a more analog style of preamplification, and I would assume that "Earned It" was processed through mostly digital gear. However, the next comparison, which will be the solid state version of the STT-1, will have the final say as to whether a more digital or analog preamplification process yields the most accurate replication.

After paying close attention to detail on the STT-1 Origin vacuum tube track, I have not found noticeable differences in sound when compared to the original song. However, just because the two signals sound the same does not mean that they will look the same on a frequency analyzer. I have imported the preamplifier track, along with the original track into Presonus Studio One and threw on a stock equalizer plug-in, simply to graphically visualize the frequency output. The following is a screenshot of the Millennia STT-1 Origin vacuum tube's frequency analysis at 00:01:03:792 (top) and the original song's frequency analysis at 00:01:03:797 (bottom).

As one can see from the graphs above, the frequency outputs are strikingly similar, only differing in a few subtle areas. These slight differences can most likely be entirely attributed to the lapse in timing between screenshots. In conclusion, the Millennia STT-1 Origin vacuum tube has done nearly an identical job of replicating The Weeknd's hit song, "Earned It."

Next up is the Millennia STT-1 Origin solid state preamplifier. After substantial listening to both the preamplified track and the original track, there are no aural differences to the naked

ear. I applied a frequency analyzer to this comparison as well, and like the Millennia STT-1 Origin solid state preamplifier, there are only miniscule differences in the waveform and its frequency output.

The API 3124+ is the first comparison that sounds slightly different. The high frequencies in The Weeknd's voice appear to be thinned out just a tad. Also, the high-end orchestral stabs in the hook are not nearly as apparent in the 3124+'s recording. This is surprising, as this preamplifier is not cheap by any means.

After listening to the API 3124+ preamplifier's recorded track, I began playing the track recorded by the Neve 5012. At first listen, there are no audible differences between its track and the original source audio. However, after listening for about 10-15 minutes, it is becoming clear that the audio sounds slightly compressed, almost to the point of light distortion or saturation. This characteristic seems to only be possessed by the vocals and not so much the drums or instruments.

The slight compression is noticeable when The Weeknd sings "So I love when you call unexpected." In the original song, lead singer Abel drops a decibel or two when he hits the word "love." This is not the case in the Neve 5012 recording. This slight amount of compression is able to color a song totally different than what it would sound like if it was recorded through a different preamplifier.

The frequency spectrum graphic seems to help exhibit qualitative characteristics in a quantitative fashion rather nicely. Therefore, here is a top-and-bottom pair of screenshots of the frequencies emitted by first, the Neve 5012 recording and then the original source audio:

Overall, the frequency outputs are similar. One cannot tell if there is compression going on through the 5012 or not, however the peaks between 500 Hz and 1 kHz are noticeably shorter on the 5012's frequency spectrum compared to the original source audio. An interesting thing to point out is that there are no other glaring differences.

After listening carefully to "Earned It" many times through my Presonus Audiobox USB, I cannot discern much difference between this track and the original song. The lows, mids and highs are still there and the dynamic range has not been compromised. There is also no hissing, fuzziness or distortion in the slightest. The funny thing is that the Presonus Audiobox USB costs just under $100, while the Neve and API interfaces retail for close to $3000.

In conclusion of my preamplifier comparison, for the most part there were little differences in tonality, timbre, dynamics and overall fidelity between the original source audio and the preamplifier recordings I conducted. With the API 3124+ recordings, it seemed the vocals got thinner in dynamic range and the high-end presence from the orchestral instruments was reduced a noticeable amount. In the Neve 5012 recordings, I detected the tiniest amount of compression. These shocked me, as such colorings in an audio signal can make or break the perfect song. Price did not seem to have a correlation with how "good" the tracks sounded, as the Presonus Audiobox USB did just as well, if not better, than all the other multi-thousand dollar preamplifiers. What should be noted is that I am not a professional audio engineer and that my ears might not be the best in the world. However, I tried as best I could to find even the most miniscule of details and discrepancies.

My preamplifier findings line up with the *Sound on Sound* shoot-out, which is encouraging news for audio engineers that don't want to waste money. The fact that many people, including myself, cannot say for certain that a preamplifier costing $3000 sounds better than a $100 Mackie 1402 VLZ Pro or Presonus Audiobox USB is disillusioning. Generally, humans are brought up, by the media mostly, to think that the more something costs, the better it

is. However, *Sound on Sound*'s findings, in supplement to my own observations, says that is not the case regarding audio preamplifiers.

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