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Analog Versus Digital Guitar Pedals, Shaping Guitar Tones and Sparking Debates

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Who would have thought that tiny metal boxes could shape an artist's entire sound? From the Electro Harmonix Big Muff to shape the Smashing Pumpkins sound on their album Siamese Dream to the Dunlop Fuzzface used on countless Jimi Hendrix recordings. Guitar pedals have become a staple in how musicians get their desired guitar tone. But although guitar pedals allow us to manipulate our guitar sound there is a debate on how that sound is produced. Many people find that there is a difference between analog and digital guitar effects. Because people are in constant debate over analog and digital guitar effects, can people actually tell the difference between one another in a blind test? And if they can, do they prefer the analog or digital effect in a test? I am going to begin this paper with a history of guitar effects and find out exactly what they are, how they have evolved and what they are like today. Afterward I will present the results of an experiment through which I explore perceptions of differences between analog and digital guitar pedals.

Whether you listen to music that includes guitar or not, guitar effects have been an important addition to music whether that be standalone effect units, effects in amplifiers, or effects built into instruments. In an article regarding the importance of guitar pedals and the mystery behind them, Keith Hatschek and Joshua Monley stated that "...the creation and refinement of new sounds for the electric guitar (or any amplified instrument, for that matter)

have often relied on effects units, frequently in the form of effects pedals, also called stompboxes since they lie on the floor, waiting for the musician to stomp on them to add or remove their contribution to the landscape of their amplified sound" (Hatschek and Monley). Guitar effects allow us to rethink the way we play music by changing how we hear the perceived sound. Whether it be using reverb to make it sound like you are playing in a concert hall or using a delay to create layered textures, guitar effects have shaped many genres of music. Not only have guitar effects shaped genres but they have also created genres that are centered around specific effects.

In the 1930s many electric guitarists who were part of big bands were able to have a chance to solo thanks to the invention of the electric guitar amplifier. The invention of the guitar amplifier allowed guitarists to have a new position in musical groups. One of the first guitar effects was discovered on accident by the use of electric guitar amplifiers. Guitarists would turn their amplifiers up in volume creating an overdriven sound effect with their electric guitar. Many guitarists enjoyed the sound that was created but found it not practical to play that loud. It wouldn't be until the 1960s that the first distortion pedal would come out on the market. Although distortion had not become an effect, many electric guitar manufacturers began to build effects right into the guitars themselves. According to an article on Reverb written by Rich Maloof on who were the first people to build electric guitars, Maloof stated that "...a guitar dubbed the Ken Roberts model, which placed a horseshoe pickup and the first–ever tremolo arm (designed by Doc Kauffman) on an archtop body built by Harmony with a full 25–inch scale."(Maloof) With tremolo arms being attached to electric guitars, guitarists were getting the first taste of manipulating the sounds of their instruments.

By the time the 1940s came around, guitar effects started to become stand-alone units. This allowed musicians to plug in different combinations of guitars and amplifiers to achieve different tones. Many manufacturers began using transistors in their designs which allowed them to control the flow of electricity. In a historical article written by Barry Clevland, Clevland spoke about the importance of transistors by stating that “The invention of transistors that followed not only let manufacturers use smaller circuits--thus making floor-model "stompboxes" possible--but also began the virulent tubes-versus-transistors debate” (Cleveland). At the time many musicians were using tube driven amplifiers which had been the norm of the guitar world. With the addition of transistors and the way they affect guitar tone, a debate was started about which of the two sounded better. With transistors readily available, many inventors began creating stand-alone guitar effects. One of the first inventors that accomplished this was Harry DeArmond of the DeArmond Company. Josh Scott, owner of JHS pedals and guitar pedal historian, stated in an informative Youtube video that “In 1946 the DeArmond company of Toledo Ohio releases the first-ever standalone guitar effects unit it's not a pedal but it is a box and you put the box on your amp and it gives you tremolo, the DeArmond tremolo control.” (00:01:19 – 00:01:33) With the introduction of the DeArmond tremolo control, many musicians began developing entire songs based around the effect. Some of the first musicians to popularize the tremolo guitar effect were Bo Diddley's “Bo Diddley” and Muddy Waters “Flood”.

Towards the end of the 1950s, many guitar amplifier manufacturers including Silvertone, Fender and Dan Electro began to include guitar effects such as reverb, echo, and tremolo inside their guitar amplifiers. Although these amps had effects built inside, the amplifiers still didn't have a distortion knob to achieve a distorted guitar signal. Many musicians at this time began to

experiment with their guitar amps to try and achieve such sound. One popular example was on Link Wray's instrumental track “Rumble” which was released in 1958. In a retrospective of Link Wray's life written by James Sullivan of *Rolling Stone*, he wrote about the incident stating that “Wray poked a pencil through the cone of his amplifier to achieve the song’s groundbreaking fuzz tone. It’s ragged, ominous chords, overdriven and dragged to a crawl, sounded like an invitation to a knife fight” (Sullivan). This effect gave Wray’s guitar a heavily distorted tone which at the time stood out from many other guitarists.

By the time the 1960s came around the guitar pedal market began to expand rapidly. In 1962 the first ever distortion pedal was released by Gibson as the Maestro fuzz tone. In an article written by Michael Dregni for Vintage Guitar Magazine, he stated that“...the May 3, 1962 patent application, the Fuzz-Tone was designed “to provide a tone modifying attachment and circuit for electrically produced signals which will permit stringed musical instruments such as guitars, banjos and string basses to produce electrically amplified and reproduced tones simulating other instruments such as trumpets, trombones and tubas.” With the tagline to imitate brass instruments, many famous musicians instantly purchased the fuzz tone and used it to write and create music with. One of the most famous examples of this effect is the main riff of the Rolling Stones song “(I Can't Get No) Satisfaction” which was released in 1965. The usage of the fuzz tone took over the guitar world and inspired many other guitar players.

In the 1970s, solid state guitar effects became increasingly popular. With the introduction of solid state effects, chorus, flanger and ring modulation began to become popular in the guitar effects world. During this time many manufacturers were working on time based guitar effects using tape machines. Although tape manipulation was the basis for developing

new effects in the 1970s, Les Paul had already been experimenting with tape manipulation in the early 1950s. In an article about Les Paul's history of multitracking, Kevin Hilton wrote that "By 1957 Paul was working with an eight-track machine, which gave him flexibility to produce more tape-based effects. He also experimented with speed manipulation – what we now know as vari-speeding – close-miking and feedback" (Hilton). With Les Paul's experimentation of tape came many manufacturers developing units for guitarists.

One of the first widely popular tape machines was the Echoplex delay developed by Market Electronics in the early 1960s. The first Echoplex machines were vacuum tube based but were not that reliable as the later versions. It wasn't until the 1970s that the third version of the Echoplex became widely popular. In a historical article about the Echoplex, Karl Briedrick writes that "The EP-3 is the Echoplex sound of the '70s. It used solid-state technology and designed by Mike Battle, the creator of the aforementioned tube versions. They tend to be more reliable than their predecessors" (Briedrick). Another important tape based effects unit came out around the same time from Roland in 1974. The Roland RE-201 or most commonly known as the Space Echo was an effects unit that created reverb and delay effects by using tape. Similar to the Echoplex it used tape to create delay repeats. By the end of the 1970s these tape effects became widely popular across many genres of music.

In the 1980s many guitarists began to switch from stompboxes to rack mount and floor multi effects units. The switch was primarily because of the interest in having multiple effects present in one compact unit that was readily accessible with a foot controller unit that could hold custom presets of guitar tones. One of the most popular units that came out at the time was the BOSS SCC-700. In an article regarding the history of the unit, Paul Youngblood wrote that

"...the SCC-700 was way ahead of its time. The SCC-700B effects board allowed you to place seven BOSS compact pedals on the board and, with an audio switcher and computer control, store 32 memories of pedal on/off status and connection sequence. The SCC-700C foot controller then recalled the 32 memories on the effects board." Although it wasn't technically an all in one unit, it was a step in the direction that guitar effects were headed. Some other popular units at the time were the Yamaha SPX90 and Roland GP-8.

Although some players began to make the switch to these new devices, players still experimented with new guitar pedals that were being developed and improved upon at the time. In 1980, Electro Harmonix released the follow up version of their Memory Man pedal with the Deluxe Memory Man which included more features. One notable user of the Deluxe Memory Man was guitarist, The Edge, of the rock band U2. In an article entitled "10 Stompboxes That Changed the World" The Edge talked about how he was inspired to make music with the pedal stating that "I just got totally into listening to the return echo, filling in notes that I'm not playing, like two guitar players rather than one—the exact same thing, but just a little bit off to one side. I could see ways to use it that had never been used. Suddenly everything changed" (Murphy). After being inspired by the Deluxe Memory Man, The Edge went on to use it on U2's 1980 album, *Boy*. By the end of the 1980s guitar effects had advanced very rapidly, however there was some major changes about to be made.

In the 1990s the grunge music genre became popular and with it came minimalist guitar effects setups that utilized the effects guitarists could get out of their amplifiers. Although pedals were not as popular during this time, there are a few that were developed that stand out. One of the most popular pedals of the 1990s was the Digitech Whammy Pedal developed by Digitech,

which was one of the first foot controlled pitch shifting pedals. A writer from Noisgate best described the pedal in an article stating that "The Whammy pedal is primarily a pitch shifting unit using the expression pedal to dictate rates of manipulation. Pitch shifters typically combine the workings of an octaver (which adds a synthesised sound one or two octaves higher or lower than the original) sound with pitch bends and harmony shifts. The Whammy digitally produces such sounds in a variety of preset settings and controlled by the foot pedal" (Mel S). Not only was the sound of the Digitech Whammy unique but it went on to establish many guitar players core sounds. One of the most prominent users of the Digitech Whammy is Tom Morello of the band Rage Against The Machine. Their debut self titled album includes use of the pedal which can prominentaly be heard on the guitar solo for the song "Killing In The Name".

As the 2000s came along, many new small companies emerged into the market and started producing their own pedals which has spread the market out. Eventually pedal manufacturers were developing digital guitar effects stomp boxes that contain multiple guitar effects inside. These became widely popular once they came out as you could have one pedal that simulates multiple pedals in one unit. One in particular that was extremely popular was the Digitech DF-7. In this excerpt, Rob Shrock explains why he enjoys using the Digitech DF-7 by stating that "The DF-7 accurately emulated the edgy buzz of my ProCo Rat and the bottomy fizz of the Big Muff. I actually preferred the modeled Big Muff because it was cleaner sounding than the original" (Shrock). Although these multi effects units were popular at first, many guitarists still sought out individual effects units for each effect. With the introduction of multi effect stompboxes guitarists began to start scaling down their setups for easy transport. This led to many companies developing a power amp in stompbox size to fit on guitarists pedalboards.

Pedals like the Mooer Baby Bomb, Electro Harmonix 44 Magnum and Orange Pedal Baby 100 feature compact size that packs enough power to drive a speaker cabinet.

As guitar pedals have progressed vastly over the last few years, guitar players have become very divided on what makes a good guitar tone. With the internet readily accessible, many people turn to online forums and Youtube videos for opinions on whether or not they should buy a certain product. This leads many consumers to make their buying decisions off of sometimes non-credible comments, which then in turn consumers end up buying the product online rather than going into their local music store. Many people in the guitar pedal industry have noticed this change and have taken note of the issue. In a recent vlog posted by Josh Scott, Scott discussed the difference between analog and digital guitar pedals and stated to his audience after a blind showcase of a not so popular pedal stating that"...a $60 digital pedal from the 90s that everyone hates on but you loved how it sounded when I played it because you didn't see it and so there's this amazing illusion that digital is bad and analog is good and that's just not true." (00:04:54 – 00:05:06). It's apparent that Scott is aware that consumers have become ruthless when it comes to what makes a good guitar tone.

Today many musicians still use guitar effects to achieve the guitar tone that they are chasing. In an interview between Allyson McCabe and Kaan Howell for an NPR article on searching for guitar tone, McCabe asked about the appeal of guitar pedals to which Howell responded "It's a real sort of alchemy lesson in trying to create a sound… What you like will be just a little different than what other people like. And so if you do take the time to try stuff, the sound you'll create will be just a little different than things that are out there" (McCabe and Howell). Since their inception, guitar effects have been an important addition to the way we

create music. Guitar effects have allowed us to rethink the way music is written by giving us a modified sound of what we are trying to create. Music has forever been changed by the addition of these effects and as innovators, we will continue to change and alter the way we create music for many years to come.

After researching the history of the guitar pedals and how they have evolved into what they are today, I pondered on the thought that if in a blind test people could actually tell the difference between analog and digital guitar effects. The idea excited me because I have not seen many experiments like this on the internet so I thought it would be a good idea to test and see the results. I decided that I want to create a test of some sorts to see if participants could actually tell the difference between analog and digital guitar effects. After browsing through many music retailer websites and music forums I compiled a group of guitar effects that are both in an analog and digital form that I could use in my experiment. The four effects I found were distortion/ fuzz, chorus, tremolo and overdrive. My hypothesis for this experiment was that the majority of participants would not be able to tell each effect apart from another.

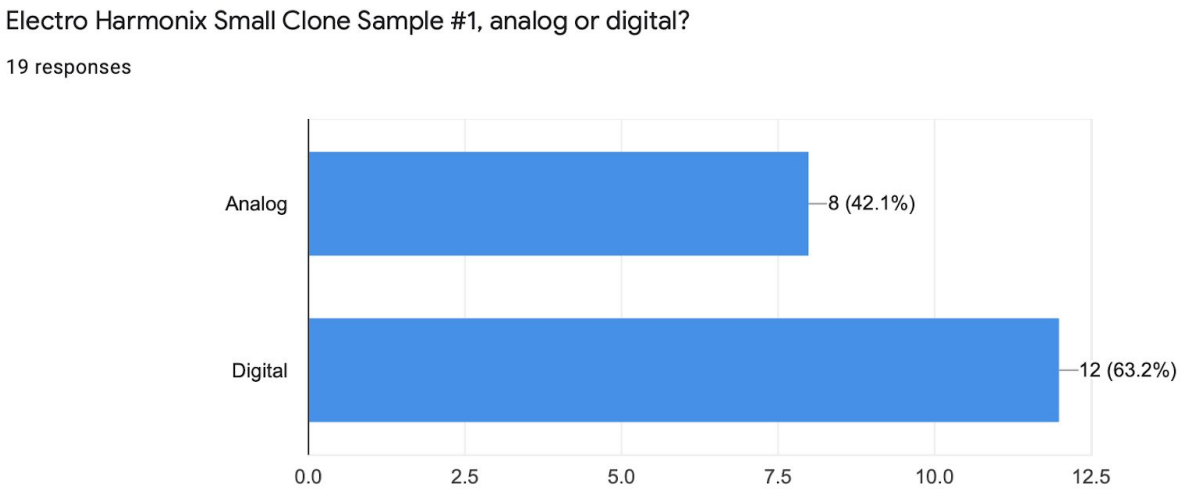
For the experiment I purchased two guitar pedals for each effect, one being analog and one being digital. For the distortion/fuzz unit I acquired an analog Pro Co Rat and a Digitech Distortion Factory. I chose these two pedals because the Pro Co Rat is one of the most famous distortion/ fuzz pedals since it was introduced in the late 1970s and the Digitech Distortion Factory was a popular digital multi effects unit in the 2000s that had many emulations of famous distortion/ fuzz pedals. For the chorus unit I acquired an analog Electro Harmonix Small Clone and a Digitech Chorus Factory. I chose these two pedals because the Electro Harmonix Small Clone is a simple one knob chorus pedal which is easy for the average user to pickup and use and

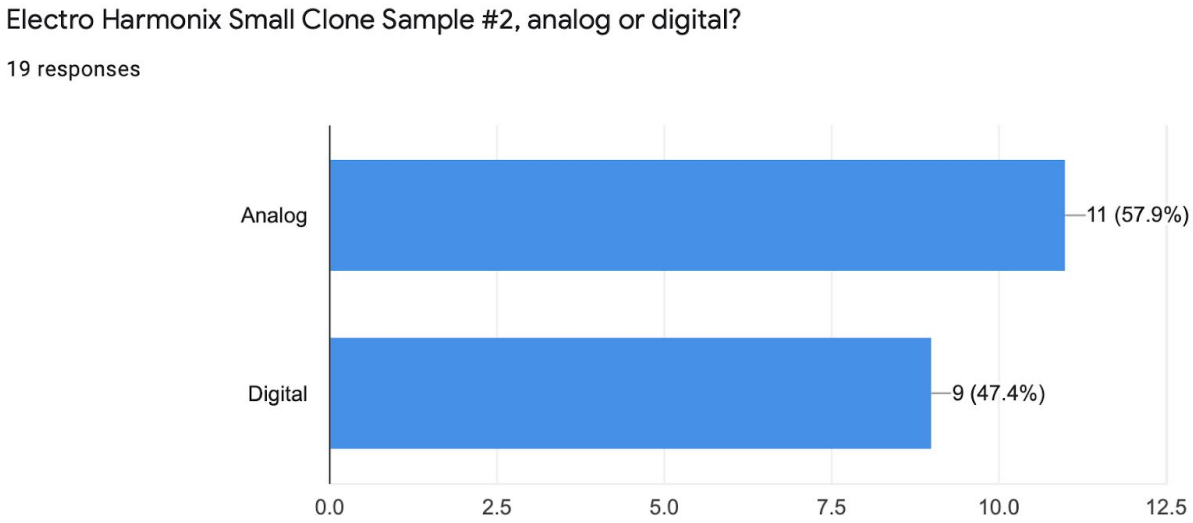
the Digitech Chorus Factory because it was a popular digital multi effects unit in the 2000s that had many emulations of famous chorus pedals. For the tremolo unit I acquired a Boss TR-2 and a Boss ME-80. I chose these two pedals because the Boss TR-2 was an easy unit to manipulate the controls for the experiment and the Boss ME-80 because it is made by the same company as the TR-2 with the same controls. Finally for the overdrive unit I acquired a Ibanez TS9 Tube Screamer and the same Digitech Distortion Factory. I chose the Ibanez TS9 Tube Screamer because it is a famous overdrive unit that has been used by many artists and I used the Digitech Distortion Factory because it had a Ibanez TS9 Tube Screamer emulation.

For the experiment I recorded a single guitar riff directly into pro tools that I then reamped through a guitar amplifier with each effect turned on separately. This would allow for no discrepancies in the experiment between each effect. After recording each effect I then organized each effect in an A/B comparison video that I then uploaded to youtube.[1] Next I created a Google Form for participants to answer questions and leave feedback for each question.[2] I then emailed the form to many students in the music department and fellow music friends. I also posted it online on many popular music review websites for feedback. At the time of writing I have had twenty people participate. Below are the graphs that the form created for each effect.

[1] guitardlord Youtube Channel in bibliography
[2] Blank questionnaire below in bibliography

Electro Harmonix Small Clone Analog versus Digital

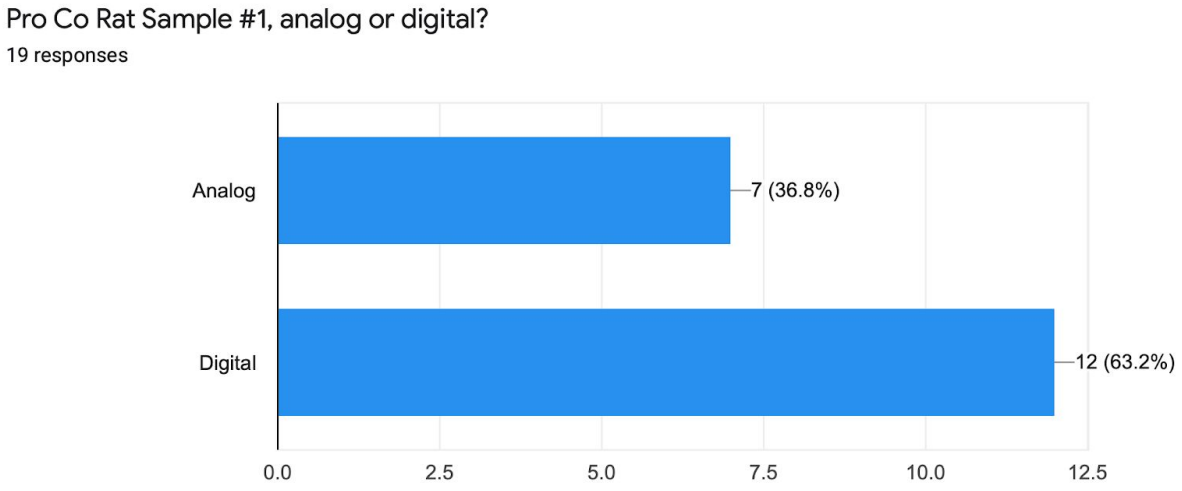


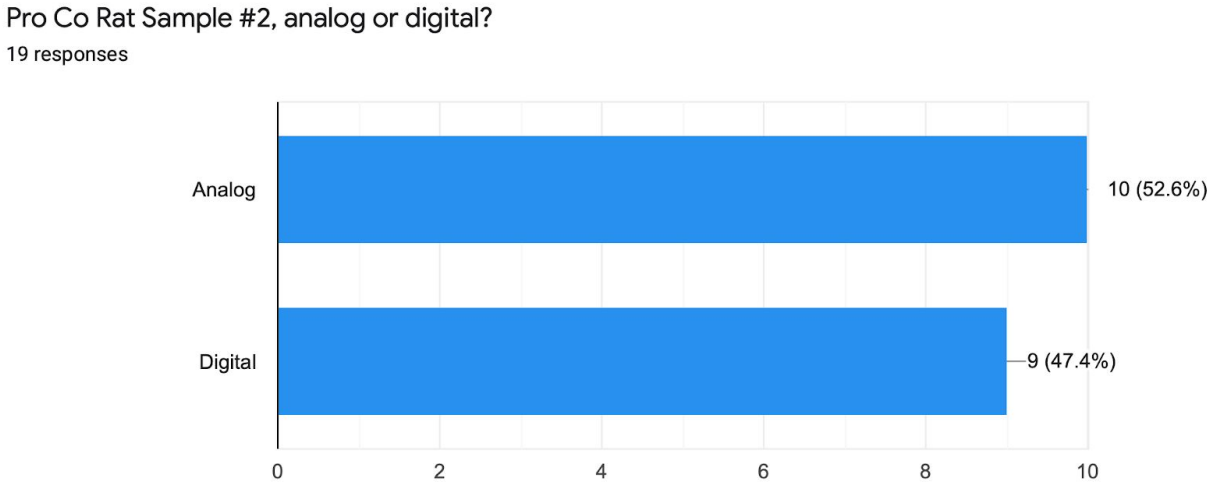


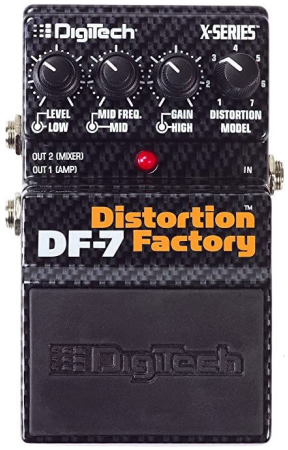
Sample 1
Analog

Sample 2
Digital

Pro Co Rat Digital versus Analog



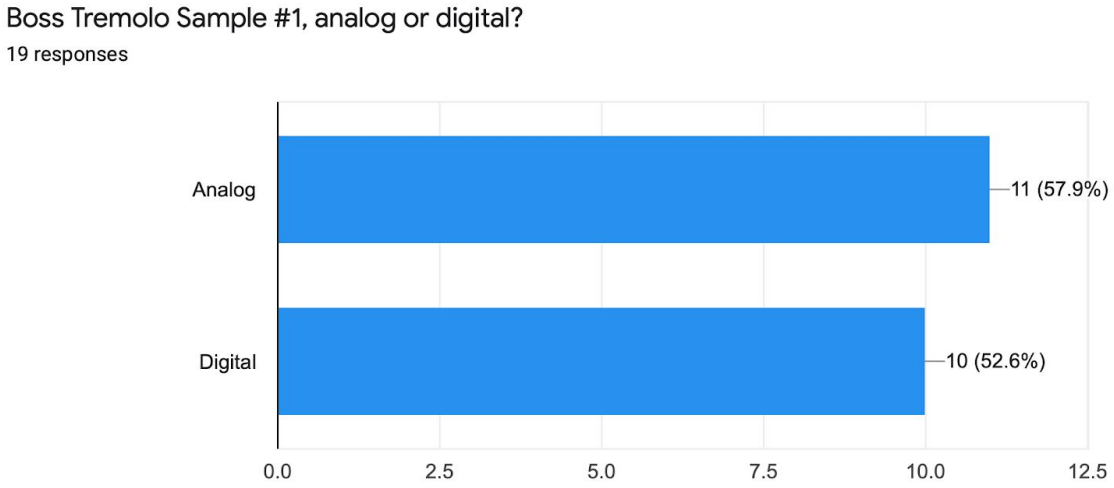


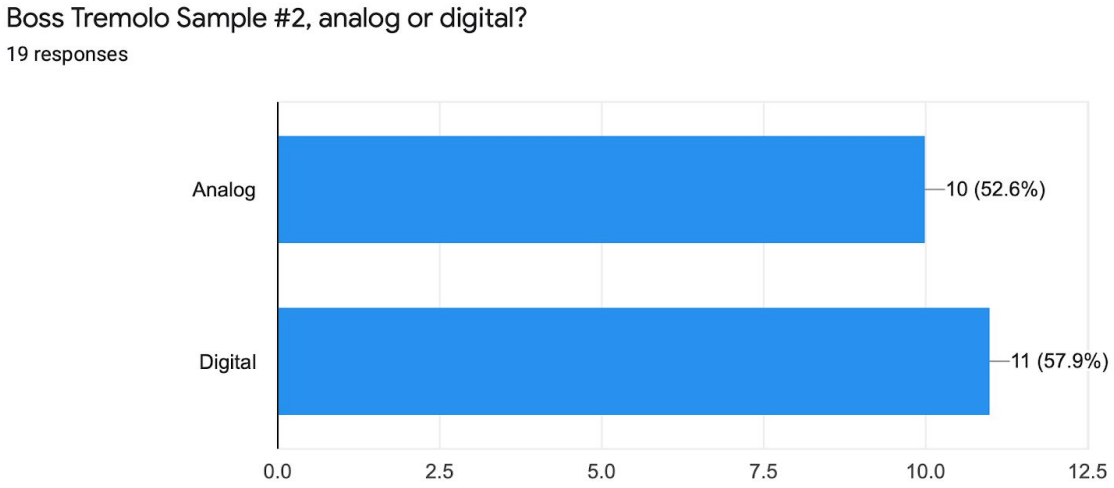


Sample 1
Digital

Sample 2
Analog

Boss Tremolo Analog versus Digital

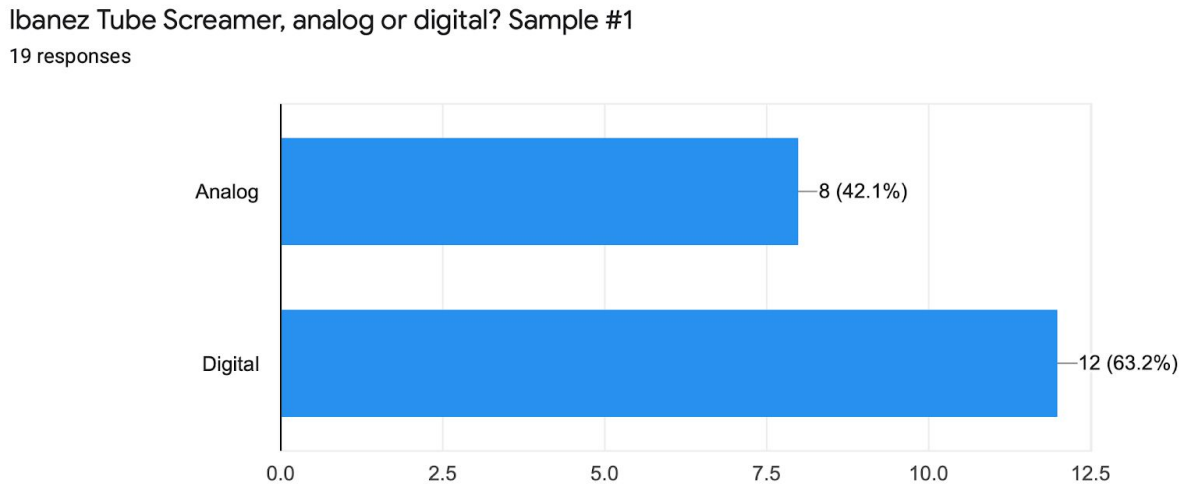


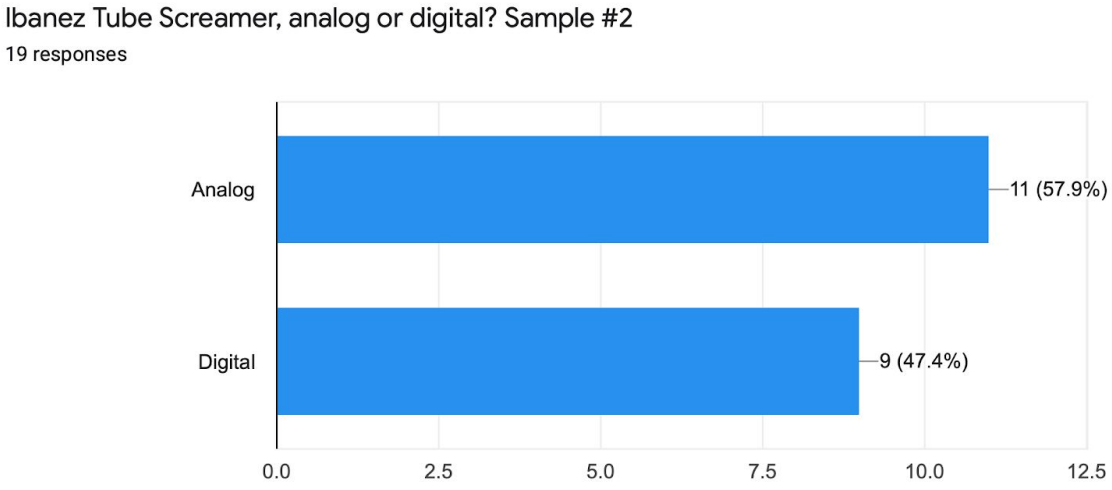


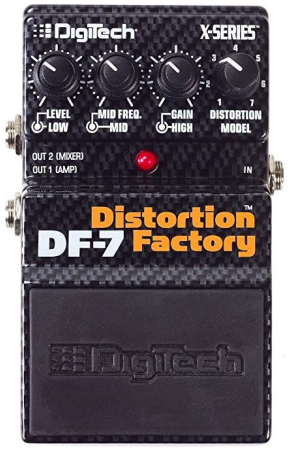
Sample 1
Analog

Sample 2
Digital

Ibanez Tube Screamer Digital versus Analog







Sample 1
Digital

Sample 2
Analog

After having the experiment online for a few weeks I then analyzed the data to understand why participants chose which sample. In the first sample of the chorus effect the majority of participants voted for the digital effect while in the second sample the majority of participants voted for the analog effect. I wasn't too surprised by these answers because I had thought that telling the difference between modulation effects was hard. In the first sample of the distortion/ fuzz effect, the majority of participants voted for the digital effect while in the second sample the majority of participants voted for the analog effect. I was really surprised that most people were able to tell the difference between the two effects since I thought they sounded really similar. In the first sample of the tremolo effect the majority of participants voted for analog while in the second sample the majority of participants voted for the digital. Although both samples were within one vote of a tie, I found it really interesting that the results were so close together. Finally in the first sample of the overdrive effect the majority of people voted digital while in the second sample the majority of people voted for analog. Similar to the distortion/ fuzz effect I felt like both samples were fairly similar. Overall the data shows that almost the majority of participants could tell the difference between the overdrive and distortion/ fuzz while modulation effects like the chorus and tremolo were difficult to identify.

To conclude, although my hypothesis was half right I think it shows that people do have an ear and are able to tell the difference between effects. I think in the long run, effects such as tremolo and chorus are almost unidentifiable if they are analog or digital unlike distortion and overdrive effects which sound best in an analog form. At the end of the day it all comes down to personal preference and what our ears are drawn too. Whatever that sound is that we hear in our heads we will continue to chase it.

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