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Introduction

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Music is an integral part of being human. A simple collection of sounds can have power over emotion, mood, and energy. The art of creating these sounds to deliver an experience to the listener is ever evolving and over the past century, has shifted into a digital realm where technology and audio engineers have the ability to drive and shape sounds in unique ways.

200 years ago, there was no possible way to make instruments sound louder using electronic technology during a performance. Neither was there any way to preserve a performance so that someone could hear it in the future. Today, innovation in technology has brought us to a point where we can do both in very complex ways. Mixing the sounds we hear is now a science and an art in itself, which consists of using technical tools in various ways specific to the instruments being mixed.

Drums, bass, piano, synthesizers, guitars, occasional brass instruments and vocals are generally rock band instruments that have been subject to contrasting mixing approaches in a live performance vs. a recording studio environment. The performers of these instruments have a duty to express emotions, moods, and sometimes deliver messages through their performance. The audio engineer has a responsibility through the capturing, editing, and sculpting of the sound to deliver the performance to the listener in a way that enhances the performance and preserves the raw emotion and message of these sounds.

There are a variety of mixing techniques used in live music venues and in recording studios. Many of these are chosen due to how they help articulate a particular emotion, feeling, or aesthetic. In addition to the inherent expressive attributes of each technique, engineers/producers must take other factors into consideration. For example, walls in a studio or feedback at a live event are environmental factors that impact the mix. Limited access to time or resources create constraints and opportunities. All of these factors must be considered when selecting among the best equipment and techniques for producing a given mix. In this paper I explore a selection of techniques, some equipment, and other considerations that impact the character of a mix in both live and studio environments. Certain combinations produce unique expressive possibilities or address unique constraints given the environmental, time, and funding context of particular live and studio recording sessions. Different techniques are used by mixing engineers for specific reasons, which are sometimes unique and vary (especially for live venues), and other times simply preference based on experience.

To gain an understanding of what these techniques are and why they are approached in specific ways with respect to the setting and situational factors that I have encountered as a live sound engineer at Palenke Arts and with my basic level studio mixing experience at California State Monterey Bay, I conducted research based on the experiences and recommendations of professionals in these fields. Despite the major differences brought upon by the live versus studio environment, there are various common mixing practices and tools used for audio such as equalization, panning, dynamic effects, and spatial effects used by sound engineers in both of these environments in order to deliver a powerful and effective performance to listeners.

Methodology

This research was conducted through a series of online articles provided by audio engineers, personal interviews with employed engineers working in live music venues and recording studios, as well as books written by audio engineers who provide insight to the many techniques used for recording and mixing audio. The live audio engineers who were interviewed have had experience capturing sound and mixing rock bands in environments ranging from small bars that provide live entertainment to professional theatres that seat hundreds of audience members.

All of the live engineers were asked about their mixing techniques such as their microphone techniques, and approaches to sound processing to include equalization, panning, compression, and effects. The following are the live engineers who were interviewed as well as brief descriptions of their experience. Joey Pendergrass is a live sound engineer for the California State University Monterey Bay World Theatre. He has a B.A. in Music with a concentration in recording technology and has worked live sound for marching bands and music festivals to include Coyote Music Festival at Cuyamaca College. Reno Bianchi is the head audio visual technician for California State University Monterey Bay who does live sound for the Black Box Cabaret as well as live production for church services. Reno has over ten years of experience as a stagehand, monitor engineer, and front of house engineer. Bryan Smith is a live sound engineer for the music venue in Vinnies Bar and grill and has worked in audio production for live music venues for 15 years. A live engineer who goes by the name of Cowboy is one of the lead live audio engineers for the Golden State Theatre in Monterey and the Sunset Center in

Carmel. Aside from interviews, some of this research was conducted through articles authored by many established professional audio engineers. Insights on the methods used by many big names in the audio production industry have become transparent and readily available to those interested in learning the ways of those who specialize in the art of mixing and the technological tools associated.

Live vs Studio

Getting sound to a live audience in a music venue requires the consideration of the nature of a space and the audience. When performers play live, they have to hear themselves, and the audio engineers have to be able to hear or have a general sense of what the audience is hearing. Live musicians are often provided monitors where they hear the collective sounds they are producing as a group. Some larger music venues have the capability to provide designated monitoring engineers whose sole responsibility is to ensure the musicians have a mix they are happy enough with to successfully deliver their performance whether it is through headphones that they wear on stage, or monitor speakers. Most live venues also have main speakers aimed at the audience in which the post processed sound is emitted. Because of the nature of speakers and microphones and the way sound is constantly running in microphones and out of speakers, feedback is one of the factors live engineers face much more often than engineers in a recording studio environment. Feedback is something I personally have had to combat while working as a live engineer as well as something which all of the live engineers that I interviewed acknowledge as a factor directly affecting the live mixing approach.

Feedback is one of the direct factors affecting a live mix. It is a prime example of an element in the live entertainment environment that audio engineers must combat. Feedback can disturb, distract, and potentially harm audience members if it is too loud. It is also demoralizing for performers as they lose their audience members as a result of a harsh sound that results in people leaving. The live audio engineer must be aware of where they place microphones in relation to the speakers outputting signal, and the acoustics of the performance venue that are prone to produce certain feedback frequencies.

Bleed is another factor commonly combatted in live sound by all engineers interviewed. It is also something I have personally had to consider while mixing live concerts for Palenke Arts and conducting live studio recordings at California State University Monterey Bay. Bleed occurs when a microphone which is designated to receive sound from a single sound source picks up sound from another sound source. Bleed is combated with certain techniques in both live and studio environments that will be demonstrated moving forward. Sound from loud instruments on stage or in the studio and monitors for the musicians are the main culprits of feedback and bleed. Sound is continuously being reflected in all directions during a performance in ways that vary depending on the location and it's physical surrounding elements.

A live venue reflects sound in different ways depending on the physical material of the floor, walls, ceiling, and objects in the venue. Both large and small live entertainment venues are prone to acoustic characteristics that affect the way a live mix must be approached for a successful concert. A larger indoor venue such as a theatre has more space and reflective material for sound to travel through and reflect off of which directly affects the way in which reverb and equalization techniques are approached. A smaller venue housing less than 100

people might have more freedom to apply artificial effects that emulate a space without encountering problems that a larger venue might face.

Larger music venues when compared to smaller venues must also take audience perspective into consideration in more complex ways. More people in a venue means that all people far from the stage, left, of the stage, and right of the stage and everywhere in between are receiving a listening experience of the same performance. The goal of the live audio engineer is to deliver this audible experience in such a way that is equal to all listeners. Panning techniques are often limited in live sound for this reason especially in large music venues.

In recording studio mixing, there is more freedom with panning and equalization. The studio goal is to get the mix to sound good in the many possible listening environments which people today listen to music in. Cars, radios, phones, home theatre systems etc. are locations that the studio engineer is mixing for. The recording engineer does not usually have to consider how things will sound to an audience member far left of a theatre and yards away from speakers.

An Engineer's Tools

Generally, the live and studio engineer has specific tools that can be used independently or in conjunction with each other to solve a sonic issue, whether it be feedback or an undesired sound. Equalization is how engineers shape the frequencies of a sound. Equalization or EQ can allow a mix to sound clear with all instruments being audible even when there are many playing at the same time. Giving all instruments their own frequency ranges, often referred to as separation EQ, can work wonders in the clarity of a dense mix and is one of the primary reasons EQ is used. Panning is the designation of sounds ranging from left, right or center of the stereo

field in a mix. Tools affecting dynamics of instruments include compression, gates, and limiters. Compression limits the extent of volume variation in a sound. Limiters prevent the sound from exceeding set decibel levels. Gates cut the sounds out that are below a certain set decibel level. These are the main tools that will be explored throughout this paper.

The Initial Sound Capture

Before any of these audio processing tools are applied to a mix, it is important to create the best sounds possible upon the initial capture. According to an interview in the article *Miking Guitar Amps On Stage,* the live engineer Marc Carolan who tours with the famous rock band Muse states "I always start with the source. Knowing what the guitarist is trying to achieve is central in my approach, and this allows me to comment on the source so that we get that right first before thinking about the mic or signal chain." When referring to the capture of guitars live, Marc Carolan acknowledges that it is important to establish whether the guitar will send a direct signal, or a signal through an amp, as this affects the sound before entering a mixer. This is true for both live and studio sessions. If a certain timbre is desired by the engineer or performer, the first step is to come close to the desired sound before the signal hits the mixing console. Amplifier settings, tone knobs on guitars, microphone placement, microphone choice, and direct input (DI) are all things that can contribute to a shaped sound pre-processing.

According to Cowboy, if something can DI'd on stage, then it should be. DI gives the live sound engineer more control. There is less stage noise when something is DI'd which means there are less chances that feeding back will occur. He prefers to DI acoustic guitars, keyboards and bass. Joey Pendegrass and Reno Bianchi also shared similar approaches to DI for these

specific instruments. Joey stated that he will often accommodate a musician that highly prefers their instrument running through an amplifier for a specific tone that is unique to their equipment. It is common that bass players go into the World Theatre and prefer not to be DI'd but to have a microphone put to their amp. For acoustic guitars, Joey will also accommodate to the performer's preference. If the performer has an acoustic guitar that can be DI'd, he will DI it, unless the guitarist prefers to have the sound captured through microphones. Joey prefers to limit his usage of microphones on stage if possible to minimize bleed.

In a studio, it is common for bass, guitars, and keyboards to be DI'd. Recording engineers will often blend the DI sound with a mic'd version of bass and guitar. In the Article *WHY GUITAR DI TRACKS ARE IMPORTANT,* JZ Recording Equipment highlights the importance of using direct input signals in a studio environment. DI signals are easier to see when compared to distorted signals coming from an amp. A DI signal can make edits easier as sonic events are more clear in the waveform. DI signals can also be processed and blended with another signal from the same sound source to add special effects and enhance an instrument.

This technique is also occasionally done live, however according to Reno, there is not always time to do this in a live setting when the goal is to get the band up and playing as soon as possible. Nor are there always extra channels on his mixer to double all of the instruments with a microphone and DI signal, which occupies two or more channels. At a small venue on a budget with minimal channels on their house mixer, blending microphone and DI signal might not be an option.

Aside from choosing and/ or blending direct signal and signal from microphones, the technique for microphone placement is crucial as well for a desired mix. How close the

microphone is to the sound source can alter the quality of the sound it receives. The angle or axis with which the microphone is placed in relation to the sound source also plays an important role in the timbre of the sound. Engineers use microphone placement techniques to acquire desired sounds and minimize problems that the environment presents.

When capturing the sound of a full drum kit in a live setting, many things are taken into consideration. According to Reno Bianchi, experience with many drum kits and microphone placements is key when knowing where to place microphones. For high hat microphone placement, he knows that facing down on the hat in between the bell and the rim is where he feels he can capture the best sound with minimized bleed from the snare and other near instruments. Joey claims that he prefers to place microphones slightly angled off axis from guitar amps. According to Joey, when the microphone is directly in front of the center of a speaker, "it can sound harsh". It is also important to note that he takes into consideration the other sound sources on stage when he angles the microphone.When miking amps, he angles the microphone facing away from loud and near sound sources to minimize bleed. These are examples of microphone placement playing a large role in the initial sculpting of the sound while also taking into consideration the environment in which the sound is occuring.

A studio setting with less worry of high sound pressure levels on stage has more leniency with experimentation for microphone placement. The proximity effect is a concept recognized by many audio engineers and is used as a tool to shape frequency. According to the article *What is "Proximity Effect"?* by SweetWater, the proximity effect is a bass boost due to the way certain polar patterns in microphones are designed. The shaping of sounds using the proximity effect is a technique commonly used by studio engineers like Stephane Elmosnino to create more low end

in a recording (Elmosnino 32). If low end is not desired in a mix, a microphone can be placed farther from a sound source. However, on a live stage, a microphone far away from the sound source is more vulnerable to pick up other sound from monitors and amps.

According to Stephen Elmosnino, there are standard studio microphone techniques that involve more than one microphone such as the XY pair, spaced pair, and blumlein (Elmosnino 35). These are techniques often used for their ability to create a sense of space and stereo width. Miking up an instrument with two or more microphones is not a common technique in live sound due to bleed on stage. Joey, Reno, Bryan, and Cowboy never seek stereo width on stage with their microphone techniques since most instruments are panned center.

The preferred microphones in a live setting by the engineers who were interviewed were dynamic microphones. It seems to be commonly agreed that in live sound, dynamic microphones are ideal since they are durable and handle the high sound pressure levels found on stage well. In the studio, condensers and ribbon microphones are used far more since they are more fragile and can be stored away in safer locations and are generally not transported as often.

Equalization

Once microphones are all set, signal is routed to a mixer, the sound can be further shaped using EQ. According to Stephane Elmosnino in the book *Audio Production Principles,* "There are three different uses for EQs: fixing, enhancing, and separation EQ." (Elmosnino 162) His general techniques for EQ are as follows: fixing is usually transparent with no dramatic boosts over 4dB and done with the instrument soloed, enhancing is done with all instruments playing,

and separation is done with all the instruments sharing a similar frequency range soloed. In the live setting feedback is an additional reason to EQ as mentioned previously.

Live sound engineer Bryan Smith shared with me a technique that he uses to prevent feedback during shows he works. Prior to the show, he purposely makes microphones feedback by slowly raising levels to the microphones where feedback might occur. Once the microphone is feeding back he will then locate the problem frequency and execute a dB cut it using a visual EQ. This technique prevents feedback during the show when a microphone needs to be turned up.

The material makeup of a room is relevant to the way EQ is approached. Based on my personal experience as a live sound engineer for Palenke Arts and as a performer in a rock band having played in various small venues, I have noticed that hard surfaces like wood, concrete, and tile often reflect sound that can result in unwanted bright tones. Material like carpet gives off warmer sounds and can cause muddiness in the low end. Other objects such as air vents can cause rumble in a room and can even cause amps and instruments to sound differently than normal because of temperature changes. As an engineer, EQ is a way to combat these obstacles. When having a conversation with Reno about combatting live factors that influence sound, he said "You're a scientist, you're a physicist, you're playing with air", when referring to the responsibility of the sound engineer to achieve a desired sound while working against the environment.

When EQing bass it is important to consider separation EQ both live and in the studio, since the kick drum and bass occupy frequency ranges usually in the same area of the frequency spectrum. According to Nick Messite in his article "6 Tips For Mixing Good Ole' Fashioned

Rock and Roll", he states that in studio mixing, the lowest register should belong to the bass. "...one instrument's fundamental must be relegated to between thirty and sixty hertz, while the other should sit in the one-hundred slot." This is referring to separation EQ which prevents one of the instruments from overpowering the other.

In a live setting, rolling off the very low frequencies in the bass below 40Hz is a technique used by Bryan for his shows at Vinnies. Bryan cuts the bass at around 100Hz to leave room for other instruments occupying that area, similar to Nick Messite's studio approach. If needed, Bryan will also boost highs around 4kHz-5kHz.

Sub-bass enhancement is a studio technique recommended by Stephane Elmosnino for bass which introduces sub frequencies and can help thicken the very low end of bass in a mix if desired (Elmosnino 86). Elmosnino recommends using audio processing plugins for sub bass in studio mixes which retain the original pitch of the bass but introduce a lowered sine wave at the same pitch, enhancing the overall sound in the low end. Cowboy follows an identical technique done in a different way for live sound on the kick drum.

When Cowboy mixes a rock band with a drum kit, he likes to use sub-bass enhancement specifically for the kick. He EQs two microphones picking up the kick drum signal separately. One is designated for the attack, EQd with highs emphasized, and the other for the lows with the highs cut dramatically and lows emphasized. He then duplicates the channel designated for the low end, and pitches it down an octave to mix it in with the other two channels. The result of this was demonstrated to me in the Golden State Theatre. The blending of this channel with the other two kick channels created a powerful low frequency rumble that resonated throughout the entire theatre and created a vibration that I could feel rather than just hear.

For the snare in rock music, a punchy snare that is prominent in the mix is usually desired. According to Roey Izhaki , "snares are often recorded with two microphones in a top and bottom arrangement"(Izhaki 230). The bottom microphone would be EQ'd to capture the rattle of the snares below the drum. For this mic, one might apply a high pass filter and emphasize the highs of the snare. Elmosnino mentions that this bottom snare is to be used at the mixing stage to brighten the snare sound (Elmosnino 76). Attack and the body or mid range of the snare drum would be emphasized in an EQ plugin for the spot mic above the snare. Triggering white noise using side chaining is also a technique Elmosnino mentions can further brighten the snare in relation to EQing.

The general approach seems to be uniform for live mixing snare. Reno, Joey, Cowboy, and Bryan all apply high pass filters for the snare. The reasoning is similar to the studio. The goal is to capture the snare sound and avoid bleed from the kick and other unwanted parts of the drum kit. Joey utilizes filter sweeps to highlight harsh tones in the snare and then cuts the problem frequency down a few dB once he finds them. This is also a technique used in the studio for EQing various instruments. Although EQ is approached similarly for live and studio mixes, time and channel limitations for Reno usually prevent him from using a second microphone on the snare bottom.

Toms are also EQ'd in the studio with filters. Izhaki mentions that the low end in toms needs to be contained. He states "The fullness and thud are around the higher lows, 200 Hz or so." This means that if not separated from the frequency range of kick and bass, things can get messy. He recommends using high pass filters. Similarly, this EQ approach seems to be uniform among live engineers. Similarly, Elmosnino recommends high and low pass filters above and

below the main frequency range of the tom for a warm tom sound (Elmosnino 77). Joey uses high pass filters to leave room for the kick in the frequency spectrum in a live setting as well.

Overheads are usually approached with heavy high pass filters both live and in the studio. Since spot mics are used for other parts of the kit, containing the higher frequencies associated with the cymbals are the goal for a rock mix. Izhaki states "a high-quality HPF is a requisite for the task." High pass filters were used by all of the sound engineers in just about every live rock show they have mixed.

Keyboards are another important element in a rock mix. EQing keyboards can be tricky since they can have a vast range depending on what is being played. Reno says that in a live setting, he will not EQ a DI'd keyboard unless something sounds harsh. Joey knows that in the World Theatre, there is a resonant frequency that is prone to feedback around 500Hz. He says he will cut this frequency if necessary. Izhaki states that in a studio mix, "Pianos, keyboards, snares, and any other instrument can benefit from low-end filtering all the same."

EQing vocals is vital in a rock mix. For a live show, the majority of live engineers I have interviewed apply high and low pass filters. Where the filters start usually depend on the vocal range of the vocalist. Reno uses EQ to compliment the frequencies most prominent in the voice. He will cut frequencies not as present in the vocal range and use this as a starting point for the mix. Bryan likes to cut any frequencies below 100Hz as a starting point. Cowboy knows that for the Golden State Theatre, 200Hz is a dangerous range where feedback is prone. He will cut 200Hz as a starting point.

In studio mixing, the approach to EQing vocals does not need to consider the feedback dangers encountered in live sound. Vocals can be EQ'd with more freedom. According to Nick

Messite, "Clean, crispy vocals are not necessarily the stuff of rock music. Heft, meat, and midrange is where the money usually lies." This can mean applying high pass filters, low pass filters, and D-essers to get rid of harsh sibilance.

Panning

Separation is also achieved through panning. Panning in a rock studio mix can get very complex. Based on my interviews with the live engineers, panning seems to be much more simple. For Reno, almost everything is panned center normally besides overheads, and toms. His reasoning is that the audience, depending on where they are positioned in the venue, would be receiving a different mix. Joey also panns overheads and toms. Occasionally he said he would pan guitars, toms, and synths/ keyboards, to achieve separation if separation EQ is not sufficient. Bryan does not pan anything, he prefers a full mono mix.

Panning is heavily experimented with in a studio rock mix. Overheads, toms, guitars, keyboards, and sometimes harmony vocals are panned away from the center of the mix. Panning is not only used in studio rock mixes for separation, but also for enhancement purposes. Izhaki demonstrates a panning technique that can be used for enhancement purposes known as the Haas technique. "...a common way to enrich and widen sounds by panning a mono copy to one channel and a delayed duplicate to the other channel." Those channels would then be panned left and right for enhancement of a mono signal. In addition to panning to achieve separation in a mix, panning is used also for enhancement purposes. Using panning for enhancement does not seem to be common in live sound.

In Mixing Audio 3rd edition, Izhaki gives a standard panning guideline for studio rock band mixes. He suggests kick drums at the center, snare toward the same location it is on the overheads, toms spread from 14:00 to 10:00, overheads 70% wide, bass center, vocals center or light panned slight left, power guitars panned hard left and right, and reverb at 100% stereo width. These panning suggestions by Izhaki do not tend to match the panning techniques of the live engineers I spoke with.

Compression

Dynamic techniques for rock band instruments also vary between studio mixes and live mixes. When I spoke with Reno, he mentioned that in a live setting, less is more. When compressing live, he likes to let the band do their own dynamics. However, he does apply compression to the drums regularly. Rarely does Reno ever apply compression to bass unless the bassist is slapping the bass. Joey also applies compression to drums and bass when necessary. Joey said for these instruments it helps to bring up the valleys and lower the peaks. Joey made a point that in live mixing, the use of compression heavily relies on the experience of the performer. He stated that he finds himself using more compression for inexperienced performers. This concept makes sense especially when compressing singers. A singer who does not know to back away from the microphone when belting out might require more compression with a low threshold than an experienced live singer who knows to control their dynamics using proximity.

Reno uses a technique for singers he calls "riding the fader". When he hears that something is too dynamic, he toggles the volume fade up and down to where he feels the dynamics are between a high and low level he likes. He then applies compression and lowers the

threshold as he moves the fader up and down less. He moves the fader less as he hears the

compression working within the parameters of where he was previously adjusting the fader.

Similar to how compressors are used in the studio, Joey, Reno, and Cowboy also use attack and

release parameters on compressors to make a kick or a snare more punchy.

Compression in the studio is used similarly however, there are other things done with

compressors which are uncommon in a live setting. Stephane Elmosnino mentions how

compressors are often used to achieve loudness (Elmosnino 186). He mentions how compressing

individual tracks, then applying group compression to various tracks can contribute to a gradual

loudness increase that is sometimes sought after when releasing a project to a commercial

market. Compression to achieve loudness is not a common technique I have encountered in my

live mixing research.

Cowboy uses compressors as limiters. By setting the compressor ratio to infinity, the

signal will not exceed a certain dB wherever the threshold lies. Limiters are used for live mixes

by Reno to prevent damage to speakers and peoples ears. Limiters are often found at the

mastering stage and occasionally during the mixing stage of a studio mix for an increase in

loudness.

Reverb And Other Effects

When speaking with Reno about using effects live, he would constantly say, "less is

more". This saying also applied to our conversation about reverb. According to Reno, as a live

engineer, you are mixing to what you hear in the room. If the room is live, bouncing, and

reflective, reverb is not needed. However, if the room is not, he will apply reverb, but minimally since he claims it is easy to wash things out (especially vocals) with excessive reverb.

When Reno does use reverb, he uses it to enhance and fix. He says reverb can help the snare sound more crisp. He also likes to use reverb on brass instruments and wind instruments. He says it helps cover the audible breathing by the performer.

Reverb and delays are often used in the studio on all instruments depending on the song's emotions. Stephane Elmosnino claims that reverbs serve the purpose of placing an instrument in a specific virtual room, enhancing tone, or to push an instrument back in a mix (Elmosnino 213). Reverb can also be EQd to have higher frequencies more present in the reflections making an instrument sound closer in a mix. Warmer frequencies in reverb reflections can give the impression of being further away since the farther away a sound is, the less the higher frequencies are present. The many parameters such as decay, pre-delay can add to tracks sounding very ambient, and dreamy if reverb is applied heavily but with caution.

Both studio and live mixing approach reverb with these concepts in mind, but according to Joey, electric rock guitarists usually have their own pedals for effects like reverb and delay. He almost never applies reverb to electric guitars. Joey and Brian also acknowledge the fact that if a guitarist wants their guitar reverbed, they normally have it on their amps or pedalboards.

Other effects that I spoke to Joey, Brian, and Reno about were chorus, flangers, and phasers. None of them use these effects on a regular basis for live shows. Reno stated that occasionally, if he is familiar with exactly how a band would like to sound based on their recorded songs, he will add these effects as they are used in the band's recorded songs. Although he would rarely use these effects, he did not express using them for enhancing or enriching

purposes. Izhaki mentions how in studio mixing, modulation tools and chorus can be used to enrich and polish sounds as well as make them broader and wider. Izhaki says chorus can also help fix slightly out of tune vocals. Phasers, and flangers are far more distinct effects used for aesthetics and their own specific sound. Experimenting with modulation effects is common in studios.

Conclusion

Over the course of my research, I have realized that audio processing techniques with the use of equalizers, panning, compression and other effects during both mixing live and in the studio intertwine. Although some of the ideas behind the techniques are shared, the different mixing environments call for a different approach when considering the specific environmental context. Mixing engineers have a common mixing language when considering concepts like separation EQ, yet the studio mix allows for far more panning experimentation where multiple audience members in a venue is not something the studio engineer has to worry about. The live engineer is focused on steering a ship that has set for the sea. Once instruments in a live setting have microphones to them and the show is in progress, the sound is at the hands of the engineer in real time where feedback and room sound are obstacles that must be fought during the show even if measures were taken to prevent them during sound check. Mixing engineers have the power to make or break a performance. They create an emotional and unforgettable listening experience, for all to enjoy using their own developed techniques from experience, as well as common knowledge shared among all mixing engineers.

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