AMBIENT NOISE REJECTION FOR PODCASTERS

Micme

One of the most common issues people are having with their podcast is controlling ambient noise and achieving a high quality, polished sound. Another huge problem is people's lack of knowledge of how microphones work as they relate to ambient noise rejection. We all know that recording studios have specifically designed, expensive sound proofed and acoustically treated rooms to record in. But what about the microphones?

I emailed 3 of the world's top microphone design engineers and asked for their help to get to the bottom of this debate. A big thanks to Bill Ryan at Telefunken, Dave Mendez at Shure and Dave Royer himself, founding member of Royer Labs for taking the time to answer my questions.

Since people usually decide to spend their time and money on buying a “magic” microphone to fix these problems. I'm going to attempt to change the mindset of podcasters by educating everyone on a far more effective way to deal with it.

Acoustic Treatment

Acoustic foam, home made baffles, heavy drapes/curtains, blankets or a pillow fort. Measures should be taken and there are a ton of really great tutorials on YouTube to help with this. Here's a great article from Sound On Sound to help you easily treat your room. And no there's nothing in there talking about sticking egg cartons to your wall. That doesn't work.

Microphone Construction

There's a ton of microphones available for all different types of applications. In a nut shell, they are designed to do one thing... pick up sound and convert it into electronic signals so we can archive and keep the sound for later use. Mics do this very well. So well, the human ear can't perceive everything they pick up. Nor can our play-back equipment reproduce it all. Here's a list of microphone transducer types:

- Condenser
- Dynamic
- Ribbon
- Carbon
- Piezoelectric
- Fiber Optic
- Laser
- Liquid
- MEMS
- Speakers

A dynamic mic uses a small movable induction coil (iron wrapped in copper) positioned in the magnetic field of a fixed magnet and attached to the diaphragm (thing that converts vibration to electronic sound signal). When we talk into the mic our voice moves the diaphragm. When the diaphragm vibrates, the coil moves within the magnetic field and electromagnetic induction happens. The construction of these mics use heavier materials making them less sensitive to sound. These mics won't react to transients as quickly recording them with less definition.

A condenser mic consists of a thin electronically conductive membrane (diaphragm) positioned closely to a thin solid metal plate. When we talk into the mic our voice changes the distance between the diaphragm and metal plate. The capacitance changes to the rhythm of the sound converting it into electronic sound signals. The light mechanics allow for condensers to initially react faster to sound and are able to record transients with better definition.

Professionally, microphones are selected depending on what they are going to record. Not every mic will work on every sound source. When selecting a mic for recording your podcast, you should try a handful first before buying. Everyone's voice is different. A $10,000 mic might actually sound worse then a $70.00 mic with your voice. Don't be fooled by the price tag, it means nothing. Most stores selling pro audio equipment let you rent microphones by the day, week or month, Take advantage of it and get the right mic.

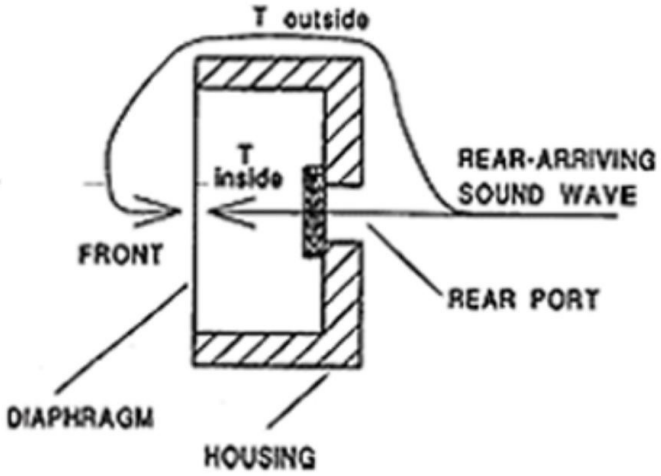
Polar Patterns

A polar pattern controls how sensitive to sound the mic is relative to the direction or angle from which the sound arrives. Simply put, mics are designed with acoustic cancellations to create the desired polar pattern.

Not so simply put... The omni (all) directional mic picks up sound from all directions and angles. The transducer (the part the picks up sound and includes the diaphragm) is put into the end of the mic body which is sealed. Because the body is sealed form the back of the transducer (part the picks up sound and includes the diaphragm) all sound contacts the diaphragm only on it's front surface. This means sound from the front presses on the front of the diaphragm and makes a signal AND sound from the sides or rear bends around to the front of the mic also pressing on the front of the diaphragm making a signal.

Now let's take the same mic body, put some holes in it behind the diaphragm and add some felt or foam (acoustic damping causing a time delay). Sound from the front is not affected. However, sound approaching the mic from the rear will travel to the diaphragm by two paths: inside the mic via the rear ports (which is delayed) and outside the mic bending around the body.

The paths will meet at the front and back of the diaphragm at the same time in phase (same amplitude level at the same time on both sides). Because of the equal and opposite pressure on both the front and back, the diaphragm doesn't react to sounds that originate from the back. These sounds make a weak signal. The polar pattern being described here is the classic cardioid where you address the mic from the front and sides with the most rejection at the back.



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So how do you get clean, quiet recordings regardless of microphone?

Focusing on just the microphone's transducer (Dynamic or condenser) is only one aspect of a handful of variables you need to take into account. Our three experts all had a similar answer to this question. A combination of soundproofing, acoustic treatment, mic technique and most importantly mic polar pattern need to be fully understood to achieve the quality of sound we all want.

Soundproofing is when the room you record in is isolated from all outside noise. To do this, build a decoupled room inside of the existing room. Floating the floor on rubber inserts ensuring that it doesn't directly touch the structural floor, building new walls at least 1 foot from the structural wall and building a drop ceiling will effectively decouple the room. Finally, using dense insulation in the new walls, ceiling and under the floor will ensure airborne and impact sound from transmitting from one structure to another.

For podcasters this method is often too expensive and may not actually be needed. However, there are few things you should still do to ensure a quieter recording:

- Remove all objects that make noise form the recording space.
- Use long cabling and move your computer out of the room.
- unplug the fridge during the time you're recording.
- turn off the air conditioner and furnace during the time you're recording.
- Record during quite times outside of your house or apartment.
- Invest in AC line conditioner to ensure the electricity running your audio equipment is clean and quiet. (lights and appliances contaminate electricity from the wall with audible noise)
- Make sure all you audio cables are running parallel to themselves to avid RF build up.

Acoustic treatment is when you pad the walls and ceiling of your recording space with dense sound absorbing material to stop sound from bouncing off the walls and back into your microphones. To have soft absorbent surfaces like rugs and couches will also help. There are a lot of cheap, easy ways to acoustically treat your room. Youtube has a ton of great tutorials to help you figure out the best way to get great results at price anyone can afford.

Acoustic treatment is one of the most important things you can do to help get great sound. When done properly, your room will be much more forgiving. The idea is to eliminate as much ambient noise as possible.

Microphone polar patterns offer ambient noise rejection from specific angles and directions. For podcasters, the combination of acoustic treatment and learning how to use your microphone's polar pattern (whether you have a dynamic or condenser). When you are looking for the right polar pattern, you want to look for a mic with a hyper-cardio or super-cardioid. These patterns are very directional with the most off axis rejection.

What The Experts Say

After researching how microphones work, we've established that the type of microphone (dynamic or condenser) alone won't be enough to improve the quality of your recordings. Career audio engineers will also agree after decades of real life application. But what about the people who actually design and build these tools?

I emailed the chief microphone design engineers at Shure, Royer and Telefunken asking them the same question. A big thanks to Bill Ryan at Telefunken, Dave Mendez at Shure and Dave Royer himself, founding member of Royer Labs for taking the time to answer my questions.

Hello,

I'm doing research on how a microphone is designed and it's ability to reject ambient noise like echo, and noise pollution. There's alot of speculation that a dynamic mic is better at rejecting ambient noise then a condenser mic. However, there's evidence that one isn't better then the other based on how they're built and what really matters is the acoustical treatment of the space being recorded in and use of the polar pattern for rejection of ambient noise.

Hopefully you can help get to the bottom of this debate.

Thank you,
Nick

All three experts returned similar answers. All eluded to acoustic treatment and use of polar patterns being the most important. They all also touched on the topics discussed above like how fast a mic responds to a sound, isolating your room from outside noise, how close the sound is to the mic and how the recording is processed after it's been recorded.

Bill Ryan's (Telefunken) answer involved location recording which usually comes with much more difficult conditions involving wind and ambient noise:

It depends on the mic and its polar pattern, and what your doing. Typically TV crews and location recordists use hyper cardioid or shotgun condensers. They use Electret Condensers because they are less susceptible to environmental issues. Dynamics typically don't have the gain required for those applications. But if you're close micing, a dynamic might be ok.

-Bill

Dave Mendez's (Shure) answer talks about how microphones have no mechanical design details that actively assist with noise rejection:

Pro mics used for performance, recording, conferencing, etc. generally do not have any active noise cancellation or processing of that nature to cancel out or actively reject noise/ambient sound and certainly this is not specifically related to dynamic vs condenser. However, it can be somewhat related to the polar pattern of the microphones and/or their overall sensitivity. As far as polar pattern goes, an Omnidirectional mic will pickup more ambient noise than a uni-directional mic (cardioid, super cardioid, etc.)

Mendez does address microphone sensitivity and how it relates to ambient noise:

If a mic is lower sensitivity, you tend to have to be closer to it to produce the desired intelligibility at comparable input gain settings. By virtue of you being closer to the mic than the other ambient sounds given a certain gain setting, your direct to ambient noise ratio makes it so you don't really hear the ambient sounds as much.

-Dave

Although this is true, it's useful to note that a less sensitive mic doesn't reject noise although you'll hear it less. And the process of mixing and mastering will effectively bring the noise up to an audible level.

David Royer's (Royer Labs) answer was the most technical talking about how a cardioid polar pattern deteriorates to an omni at low frequencies:

The use of a specific type of transducer (i.e. electrodynamic or capacitive) is a minor issue at best; either type can give a rejection of unwanted sound that ranges from poor to quite good, depending on several different factors that are often happening together and interacting.

To start with, DYNAMIC microphones sometimes SEEM to give better "rejection"; this is often due to the simple fact that many CARDIOID dynamic microphones are deliberately designed to have a severely restricted response at LOW frequencies and a reasonably well-controlled polar pattern over their working range. By contrast, many cardioid CONDENSER microphones have very good low-frequency response COMBINED WITH a polar pattern that deteriorates to practically an OMNIDIRECTIONAL pattern at low frequencies.

Royer also offers an interesting noise cancelling mic technique that dates back decades involving two omni microphones:

If you have TWO identical omnidirectional microphones close together and connected OUT OF PHASE with each other, sounds that have their source at some distance from the two microphones will produce "equal-but-opposite" outputs from the two microphones and the outputs will cancel. HOWEVER, if the desired sound source is substantially CLOSER to one of the microphones than it is to the other, the cancellation for the "close" sound will be far less severe than it is for a distant sound and the rejection of unwanted background sounds can be very good indeed.

-David Royer

In Conclusion

If you want to make a big difference in the quality of your podcast's fidelity, this is where to start. Remove as much noise as you can from your room. use acoustic treatment techniques to dampen reverb and reflections, select the right mic for your voice, learn proper mic technique and learn how to use your mic's polar patterns for maximum noise rejection.

After you have set your room up to record clean, quiet and crisp raw audio the next step would be to spend some time learning about what digital processing tools you have available to you on you digital audio workstation (DAW). All DAWs ship with a suite of basic fundamental audio processors like gates, EQs, compressors, de-essors and dither. An understanding of how to apply these tools to your podcast will set you apart from pack.

Thank you for reading! I hope you found this valuable and I hope you can put as much as this into practice as possible. I firmly believe that a great sounding podcast will help you attract a stronger listenership. As podcaters, the medium we work in is audio.

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