THE SOUND QUESTION

# MAKE AUDIO MAKE SENSE

## WHY MUSIC SOUNDS THE WAY IT DOES



FROM THE PERFORMANCE TO YOUR EARS

FROM RECORDING AND MIXING TO SPEAKERS, ROOMS AND THE LISTENING EXPERIENCE.

A NOTE FROM THE CURATOR

# Why The Sound Question?

My name's Cory. My interest in music started pretty young. When I was a kid, my family ran a hotel, and there was a piano in one of the living rooms. Dad played guitar and really wanted me to learn piano. I messed around with it, but I wanted a guitar too. An electric, of course. He eventually gave in when I was around 11 or 12.

I didn't have a guitar amp, but the family had a Denon amplifier, a pair of Cerwin-Vega D5s, a five-disc CD changer (one of the first on the block to have one!), and a tape deck.

Luckily, there was an old trick. Throw in a blank cassette, hit Record and Pause, flip the monitor switch, plug your guitar into the microphone input and... bingo! A free guitar preamp feeding the Denon. My parents, and probably half the people in that hotel, weren't quite as thrilled with the discovery.

I grew up listening to, and trying to learn, a pretty broad range of music. My father's old country and southern rock, my mother's mix of '70s pop, classic rock, newer country and country rock (the Eagles were a big one!), and eventually my own teenage interests in everything from Floyd, Zeppelin and Frampton to Pearl Jam, Soundgarden and Linkin Park.

It was through all that music that I started noticing differences beyond the obvious ones between genres.

Even on the radio, different recordings seemed to have their own distinct sound. To my ears, a Proclaimers or Dire Straits recording might have more "openness" or space around the instruments than something by Foo Fighters or Oasis. I might actually like the Foo Fighters song better, but still prefer the *sound* of the Proclaimers recording.

Listening through the stereo at home made those differences even more noticeable. I started wondering what actually made one recording sound so different from another.

Around the same time, I was getting interested in audio equipment. By then, I'd moved into a different house where I could really crank the stereo without bothering hotel guests, and found out that the Denon and Cerwins could really rattle some windows. My uncle lived down the road and had a Yamaha amplifier with more power than the Denon, along with some Pioneer speakers. But even playing the same CDs, I thought it sounded... different?

It was loud, sure, but it didn't quite melt your face off like those D5s. Sometimes it seemed like there was a blanket over the speakers. The cymbal hits didn't jump out as much, and the guitars weren't nearly as "in your face." As I remember it, the Pioneers were about the same size as the Cerwins, with 12-inch woofers too. Still a very different presentation.

Was it the amplifier? The speakers? Something else entirely? I had no idea. I just knew I could hear the difference.

## A NOTE FROM THE CURATOR / CONTINUED

Over the years, I've kept playing guitar, dabbled in bass and drums, recorded guitar covers for my personal YouTube channel, and experimented with all kinds of audio equipment. I eventually learned about speaker sensitivity, horn-loaded tweeters and some of the reasons those Cerwins could play so loud and sound so lively. Their design had a lot more to do with that experience than I understood at the time.

And that Yamaha amp? It's an A-720. My uncle gave it to me about ten years ago. Thirty years on, it's my daily driver.

So I guess that answers at least part of the question I had back then. It wasn't necessarily the Yamaha I didn't like. Those Pioneers just never did much for me. Paired with my Paradigm Phantom v1s, though, that same amplifier is a completely different experience.

What I enjoy now is the balance. The guitars and vocals have their place, the cymbals have detail without taking over, and some recordings seem to spread well beyond the speakers. It's the kind of sound where I can follow an individual instrument or just sit back and take in the whole band.

As I've learned more about speakers, I've come to think the Phantoms' fairly even tonal balance, consistent sound off to the sides and wide-spreading tweeter have a lot to do with that sense of space. The Yamaha is part of the system, but it can't create those effects on its own. The recording, speakers, placement and room all have a say.

And I still have a soft spot for those Cerwin-Vega D5s. They weren't the most spacious or precisely placed presentation I remember, but they had punch, attack and an almost physical way of putting the music in front of you. Not the same experience as the Paradigms at all, but every bit as enjoyable in its own way.

Funny how two systems can make you love the same music for completely different reasons.

**The Sound Question is really an extension of that curiosity.**

I'm not an audio engineer or professional musician (my covers should prove that ;-)). I'm a music enthusiast who still listens to a ton of different music and wants to understand what makes a recording sound the way it does, what our playback equipment **actually** contributes, and whether the things we're told about sound quality really hold up to scrutiny.

And I figure there are probably plenty of other people asking some of the same questions I asked back then, and still ask today. I'd like to make it a little easier for them to find answers without having to scour the entire internet.

The goal is pretty simple: ask questions, look at the evidence, and explain what we find without needing an engineering degree or a lifetime of audio knowledge to follow along.

## MUSIC FIRST. QUESTIONS ALWAYS.

A FIELD GUIDE TO THE SOUND

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39 ILLUSTRATED LESSONS / 17 THEMES


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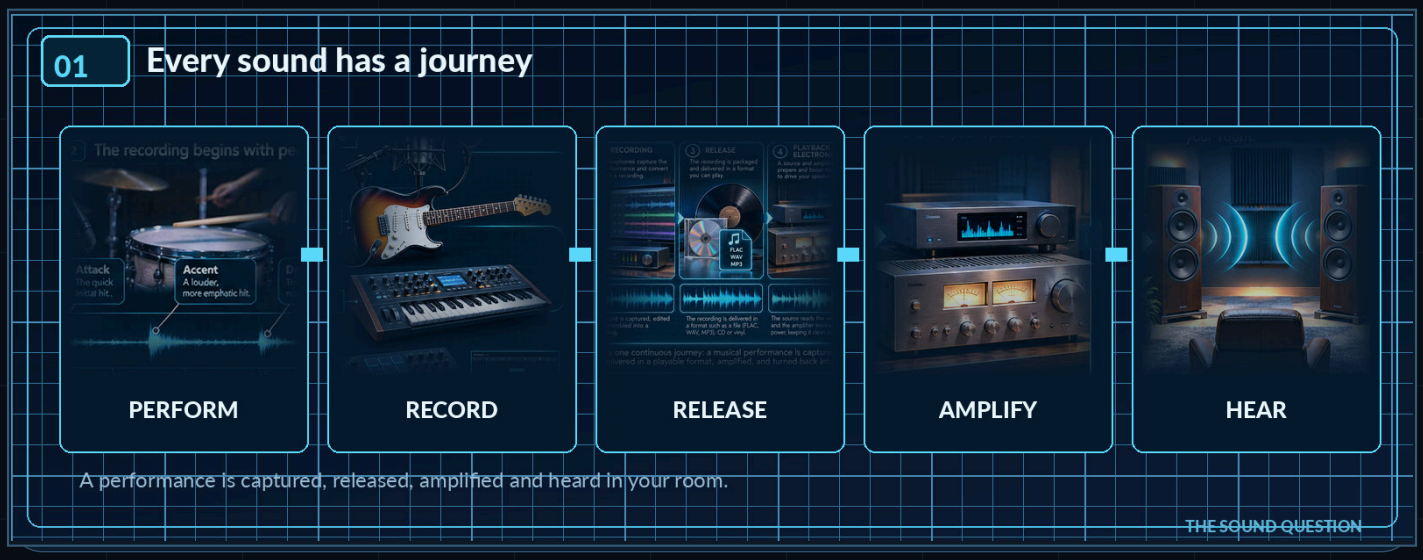
16 BUILDING A SYSTEM 1 lesson

17 TROUBLESHOOTING 1 lesson

01 / THE BIG PICTURE

# Every sound has a journey

Before an amplifier or loudspeaker can change anything, a performance has already been played, captured, arranged and prepared for release.




### START WITH THE MUSIC

A player hits a drum, sings a note or plucks a string. That sound can be recorded with a microphone, captured directly from an instrument, or created electronically. The original performance and its musical arrangement already have a personality.

### THEN FOLLOW THE CHANGES

Recording, mixing and mastering shape what is saved. A file, disc or record stores or carries that result. Playback equipment then turns it back into sound, while the speakers, room and our ears complete the experience.

### ONE USEFUL HABIT

Whenever something sounds different, ask which stage could have changed. A new master, the volume level, headphones, speaker placement and a different amplifier are not the same experiment.

> **KEEP THIS IN MIND**
> The final sound is the result of a chain. Do not blame the last box in the chain before checking what came before it.

**EXPLORE THE LESSON ONLINE**
The Sound Journey

02 / PERFORMANCE

# The performance comes first




## WHAT TO LISTEN FOR

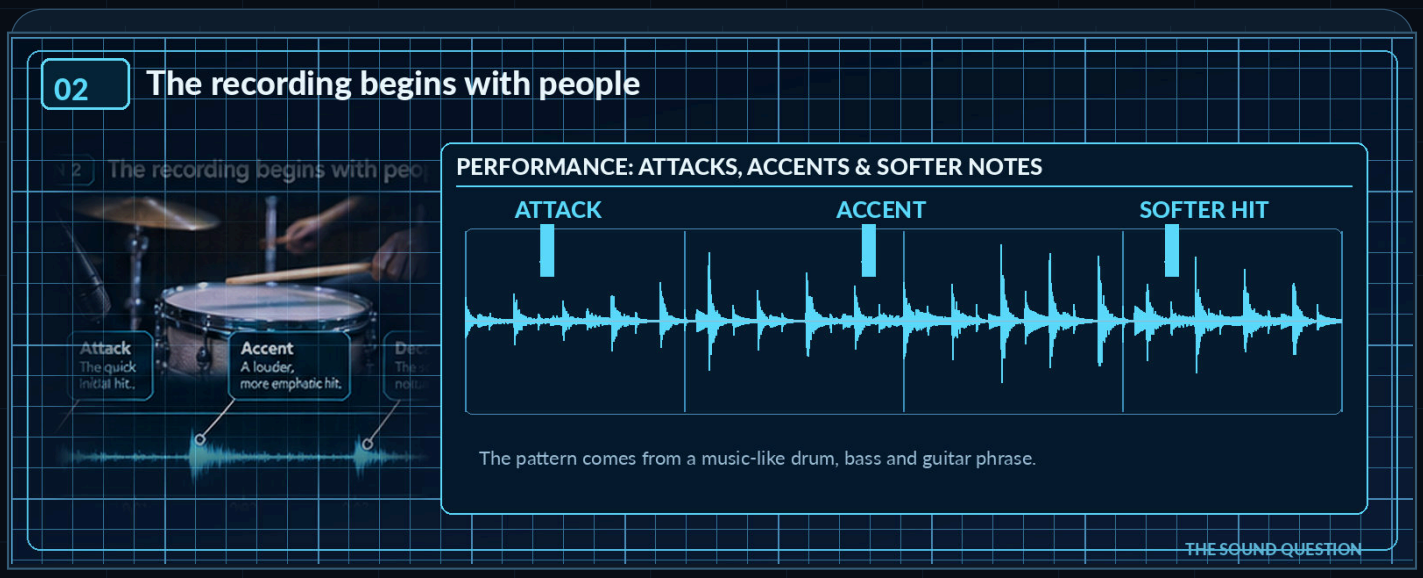
A note or drum hit already has an attack, an accent and a changing level before the microphone is switched on. Look at the performance waveform, then explore how the players create that shape.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

02 / PERFORMANCE

# The recording begins with people

A sound can feel alive, relaxed, heavy, sharp or restrained before any studio processing is added.




## WHY THE PLAYERS MATTER

The strength of a drum hit, the way a guitarist slides into a note, and how a singer phrases a line are part of the sound. Even at the same average volume, one performance may feel more powerful because the musicians play together differently.

## GROOVE IS NOT A NUMBER

A drummer can create a hypnotic pulse through timing, accents and the space between notes. Complex parts do not automatically groove more. A song can build tension through arrangement and repeated patterns even when a loudness meter barely moves.

### FROM THE CURATOR'S NOTES

*I grew up trying to learn everything from old country songs to Led Zeppelin and Soundgarden. Some of my favourite moments are not the loudest ones. They're when a rhythm section settles into a groove, or when a repeated part finally comes together with the rest of the band.*

## THE RECORDING CANNOT INVENT THE ENTIRE PERFORMANCE

Production can change balance, tone and impact, but a more expensive microphone does not magically provide a better musical idea. Sometimes a rough, lively recording is more engaging than a technically polished one.

### KEEP THIS IN MIND

Listen to the interaction between instruments before deciding whether the equipment is the reason a song moves you.

EXPLORE THE LESSON ONLINE

Recording sources and microphone placement

03 / RECORDING

# Four ways to capture a song




## WHAT TO LISTEN FOR

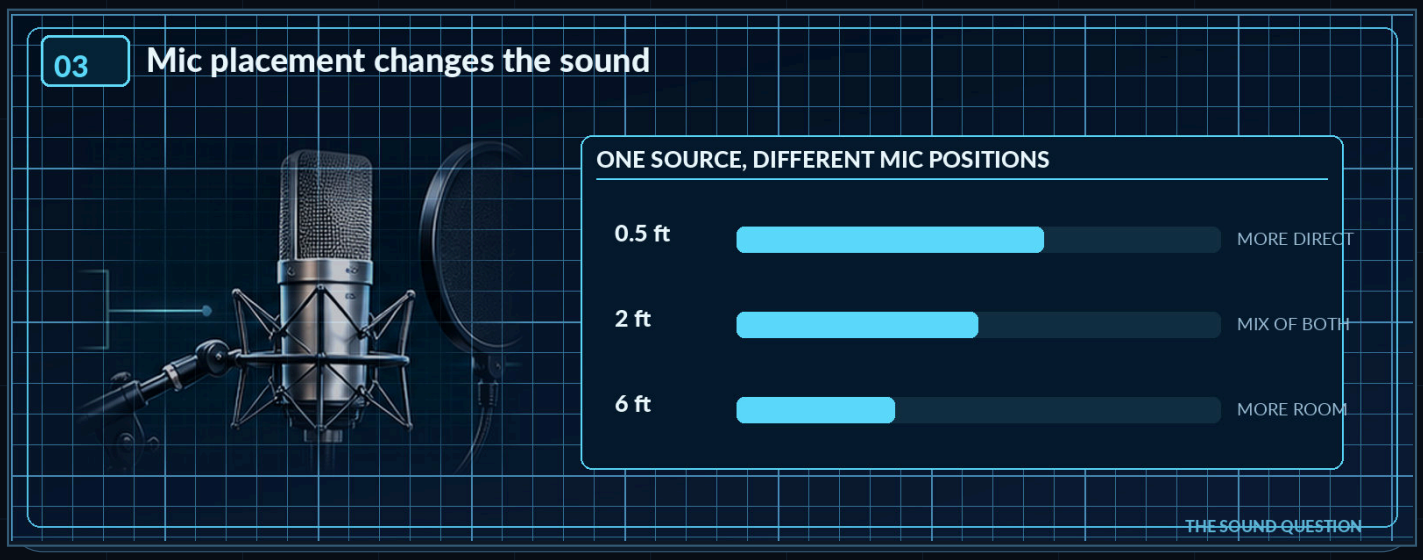
Microphones, direct instruments, synthesizers and MIDI instructions take different paths into a recording. A recognisable instrument and a clear signal path make that easier to see.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

03 / RECORDING

# How a microphone changes the picture

The same voice or instrument can sound quite different just by changing the distance and direction of a microphone.




### CLOSE IS NOT AUTOMATICALLY BETTER

A close microphone often captures a higher share of the direct sound and less of the room. That can make a voice intimate or a guitar very clear. Move it back and the reflected sound in the room becomes more noticeable; the sound may seem farther away.

### MICROPHONES HEAR IN DIFFERENT DIRECTIONS

A cardioid microphone tends to favour sound in front. An omnidirectional one hears more evenly around it. A figure-eight pattern is sensitive front and back, but reduces sound from its sides. These are simplified descriptions: real microphone patterns vary with frequency.

### THE ROOM BECOMES PART OF THE TRACK

Reflections, floor and wall surfaces, microphone angle and directional-microphone bass changes can all affect the recording. An equalizer or amplifier at home cannot reliably reverse every decision made during recording.

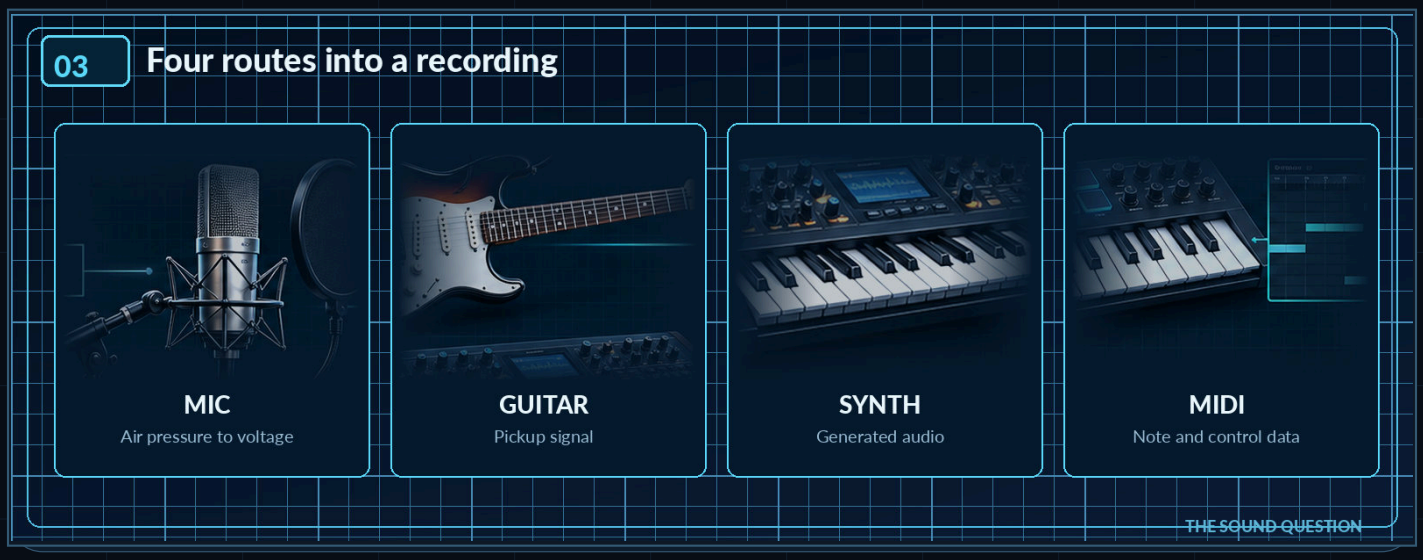
> **KEEP THIS IN MIND**
> When two recordings have different ambience, the difference may have been captured in the room, not added by your speakers.

**EXPLORE THE LESSON ONLINE**
Recording sources and microphone placement

03 / RECORDING

# Four ways to get a sound into a recording

Not every song starts with a microphone. A computer can receive sound or musical instructions in several different ways.




### MICROPHONE OR DIRECT CONNECTION

A microphone converts motion in the air into an electrical signal. A guitar, bass or keyboard may instead connect through a suitable instrument or line input. An audio interface adjusts that analogue signal and usually converts it into digital samples.

### ELECTRONIC AND VIRTUAL INSTRUMENTS

A synthesizer can generate an audio signal itself. MIDI is different: it tells an instrument which notes and controls to use, but the MIDI instructions are not the recorded sound wave.

**FROM THE CURATOR'S NOTES**

*My first electric guitar didn't have its own amp. A cassette deck with a microphone input and live monitoring could boost the guitar's weak signal before sending it to the family Denon stereo. With Record and Pause engaged, the tape stayed still while the incoming signal passed through. That's why the trick worked. A mic input isn't designed specifically for guitar pickups, though, so its sound could be noisy, coloured or distorted. The actual speaker-driving power came from the Denon.*

### LEAVE ROOM FOR SURPRISE PEAKS

The input can distort before the recording meter shows a problem. A conservative recording level gives unexpected loud notes room to fit. Modern 24-bit recording makes it practical to keep generous headroom rather than chasing a meter that nearly touches the top.

**KEEP THIS IN MIND**

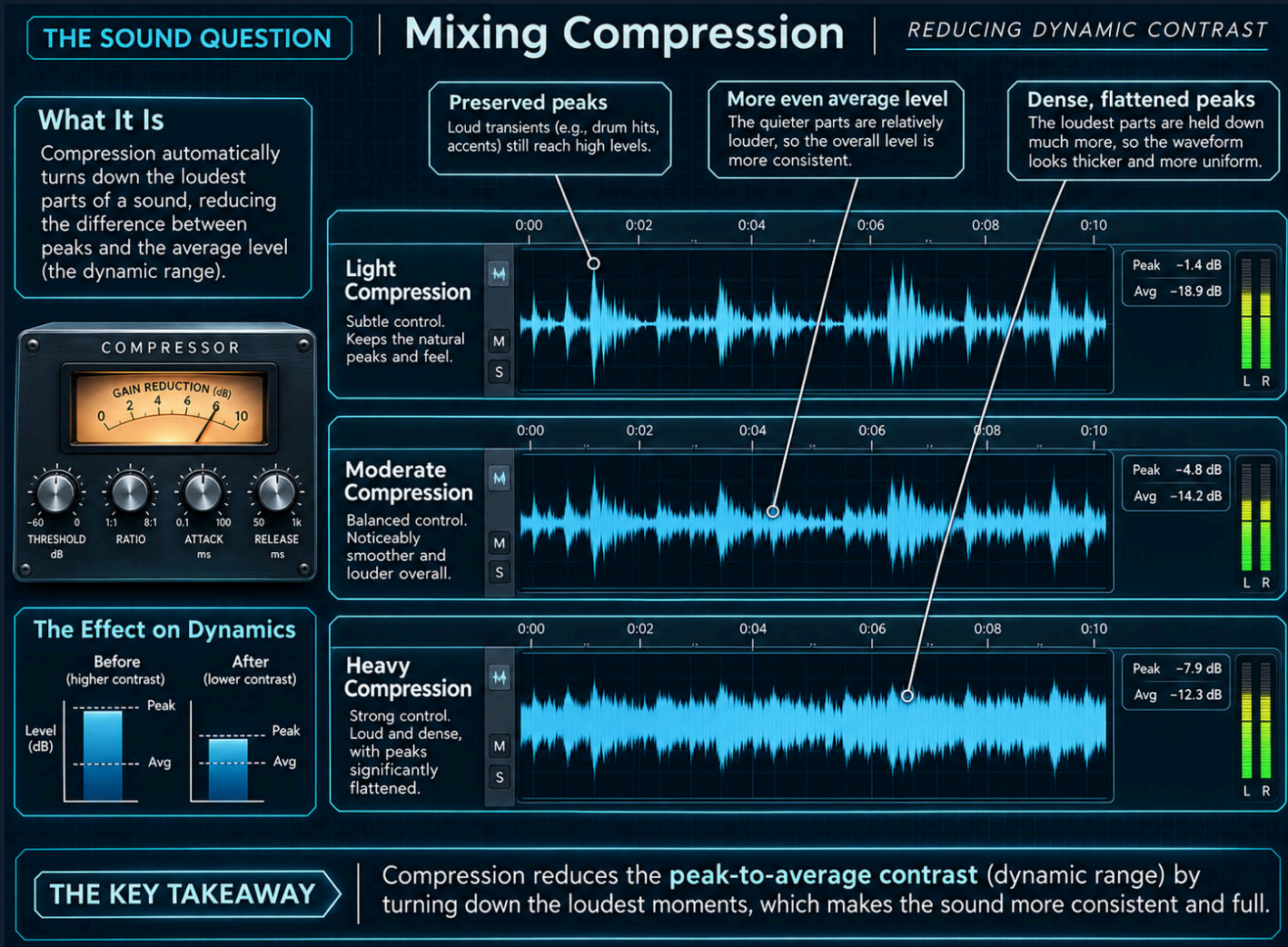
Recordings may contain microphones, direct instruments, synthesizers and software sounds. The route matters more than the label on the box.

**EXPLORE THE LESSON ONLINE**

Recording levels and resolution

04 / MIXING

# Shape the individual parts




## WHAT TO LISTEN FOR

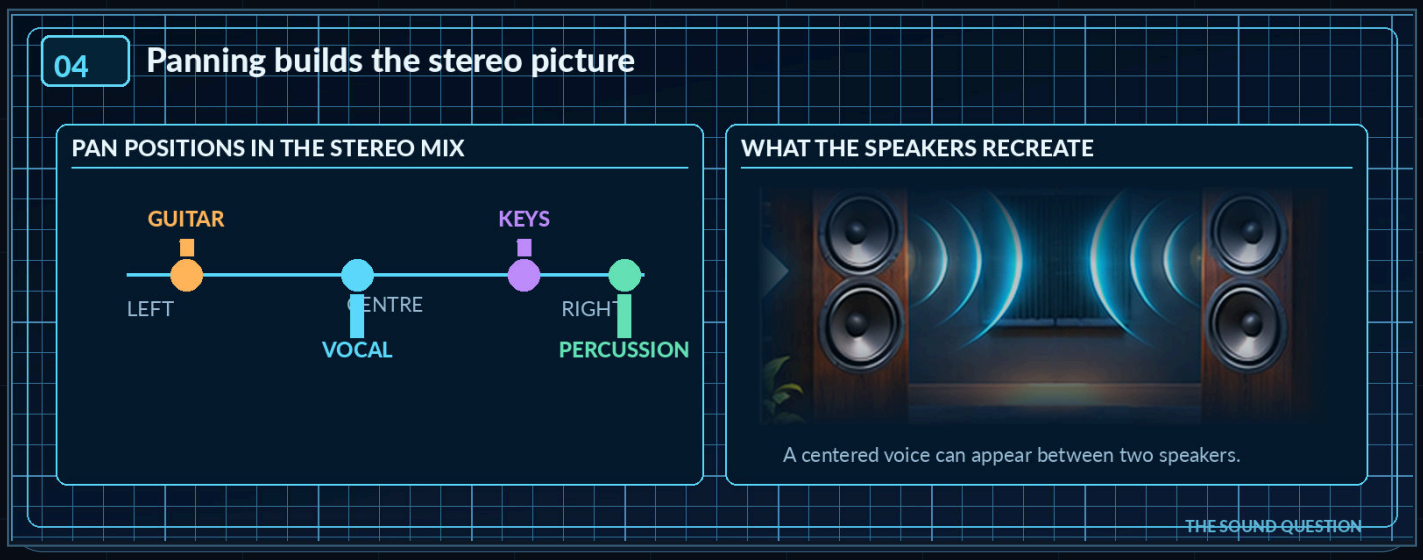
Compression is one of several tools used during mixing. Compare the same musical phrase with different peak-to-average balance, then look at placement and masking in the pages that follow.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

04 / MIXING

# Who put that guitar over there?

Stereo mixes create a picture between the left and right speakers. Many of those positions were chosen long before playback.




### PANNING IS DELIBERATE

In a stereo mix, a centre vocal can appear between your speakers even though no speaker sits there. The engineer can move a guitar left, spread backing parts wider, or keep the bass focused near the centre. These choices help build the scene in the recording.

### DEPTH TAKES MORE THAN LEFT AND RIGHT

Level, tone, reverb, delay and the balance between direct sound and reflections can make instruments seem closer or farther away. Your loudspeakers and room affect how convincingly those recorded clues reach you.

### WIDER IS NOT ALWAYS BETTER

Extreme width can sound dramatic, but it may weaken the centre or behave oddly when mixed to mono. A narrow mix can be a perfectly intentional musical choice.

**KEEP THIS IN MIND**

When you hear a wide stage, part of it may be in the recording. A DAC or speaker alone does not invent the musician positions.

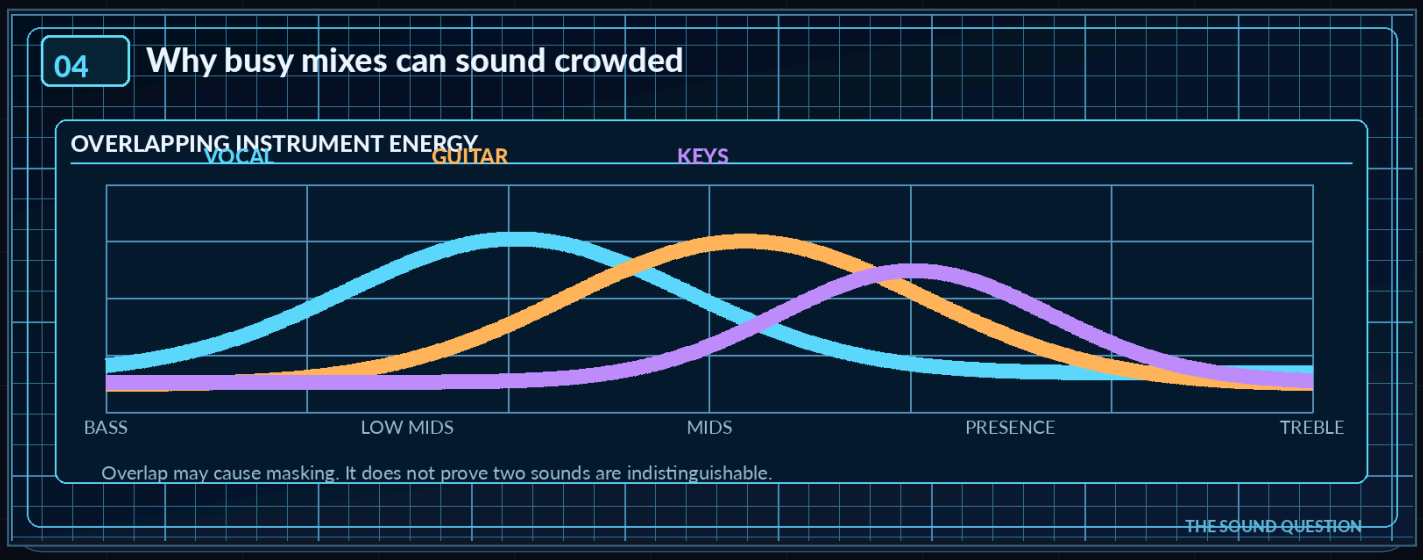
**EXPLORE THE LESSON ONLINE**

Mixing and soundstage

04 / MIXING

# Why does a busy mix sound crowded?

Sometimes several instruments compete in the same part of the sound. It gets harder to follow them separately.




### THINK OF SEVERAL PEOPLE SPEAKING

If three people talk at once, a quieter sentence may be difficult to follow. In music, a thick guitar part can cover part of a voice, and bass instruments can compete with the weight of the drums. This is often described as masking.

### AN ENGINEER HAS SEVERAL OPTIONS

The mix can use volume, playing arrangement, tone changes, timing, panning and selective compression to make room. Turning up every track rarely solves the problem. Sometimes the musical goal is a deliberately dense wall of sound.

**FROM THE CURATOR'S NOTES**

*While working on my guitar-cover recordings, I learned that getting the guitar to sit naturally with the backing instruments wasn't always a matter of turning it up. I wanted it to feel like part of the band, not something pasted over the top. What was competing with it mattered just as much as the guitar's own level.*

### THE SYSTEM CAN ADD ITS OWN DIFFICULTY

A speaker, room or struggling playback stage might make a dense mix seem less clear. But a congested recording and a system that becomes congested only at high volume are different possibilities. One listening impression cannot prove which is responsible.

**KEEP THIS IN MIND**

Separation is not just left/right spacing. It also depends on how sounds overlap in pitch, time and level.

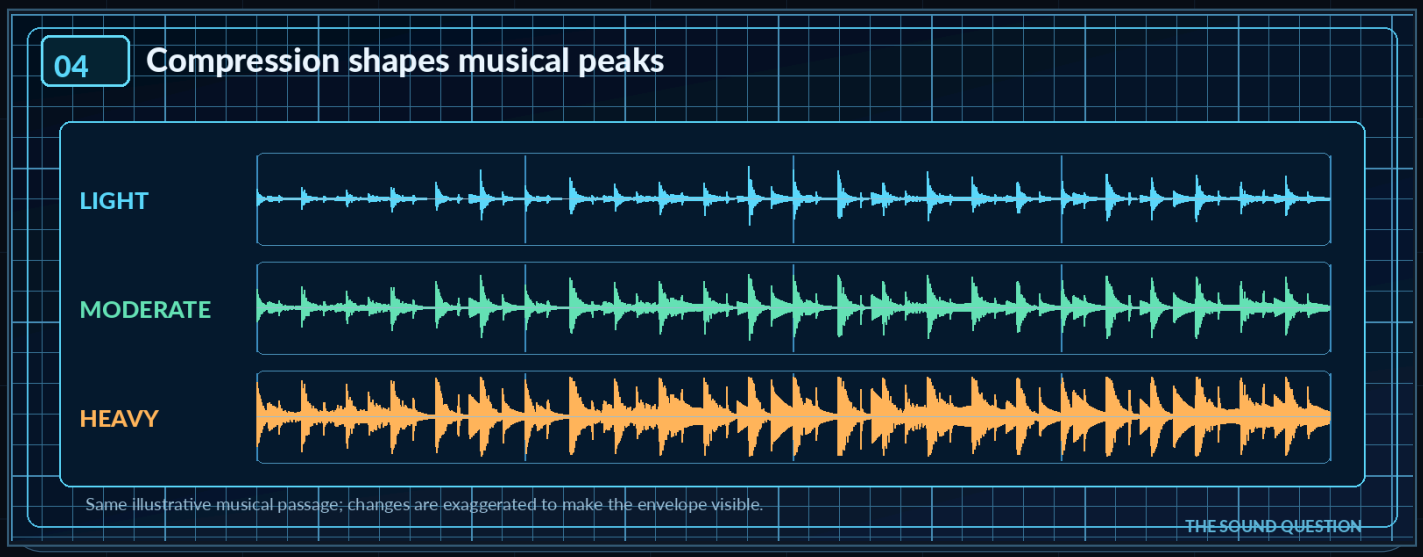
**EXPLORE THE LESSON ONLINE**

Mixing and soundstage

04 / MIXING

# Compression is a tool, not a verdict

A compressor responds when a sound gets stronger. That can help individual parts sit together, or it can reduce their punch.




### WHAT DOES IT DO?

Imagine a singer whose loudest words jump well above the rest. A compressor can reduce those louder moments by a chosen amount. After adjusting the overall level, the quiet parts may be easier to hear. A drummer, a bass line and a vocal may each need very different treatment.

### PUNCH IS MORE COMPLICATED

A strong drum attack is the brief leading edge of a hit. Depending on how it is set, a compressor can soften that attack or let it through and control the sound that follows. Faster does not always mean better.

### MUSICAL DYNAMICS SURVIVE IN SEVERAL FORMS

A song can have emotional rises and falls from the playing, arrangement, changing instrument layers and timing, even if a meter shows modest changes in loudness. Do not confuse a single loudness number with how dramatic a song feels.

**KEEP THIS IN MIND**

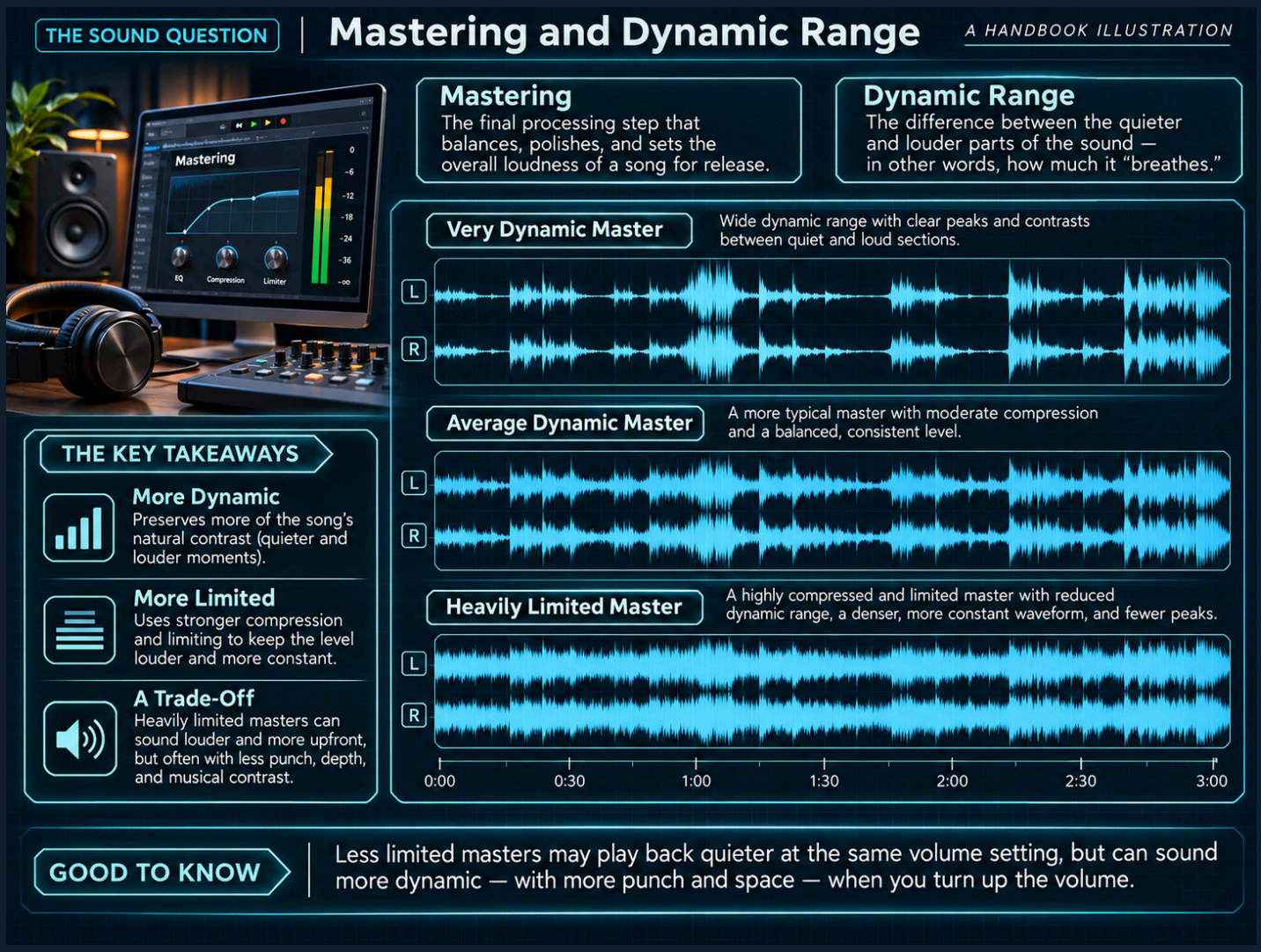
Compression can be useful, excessive or irrelevant. Listen for what changed instead of judging the word alone.

**EXPLORE THE LESSON ONLINE**

Mixing and soundstage

05 / MASTERING

# One song, several releases




## WHAT TO LISTEN FOR

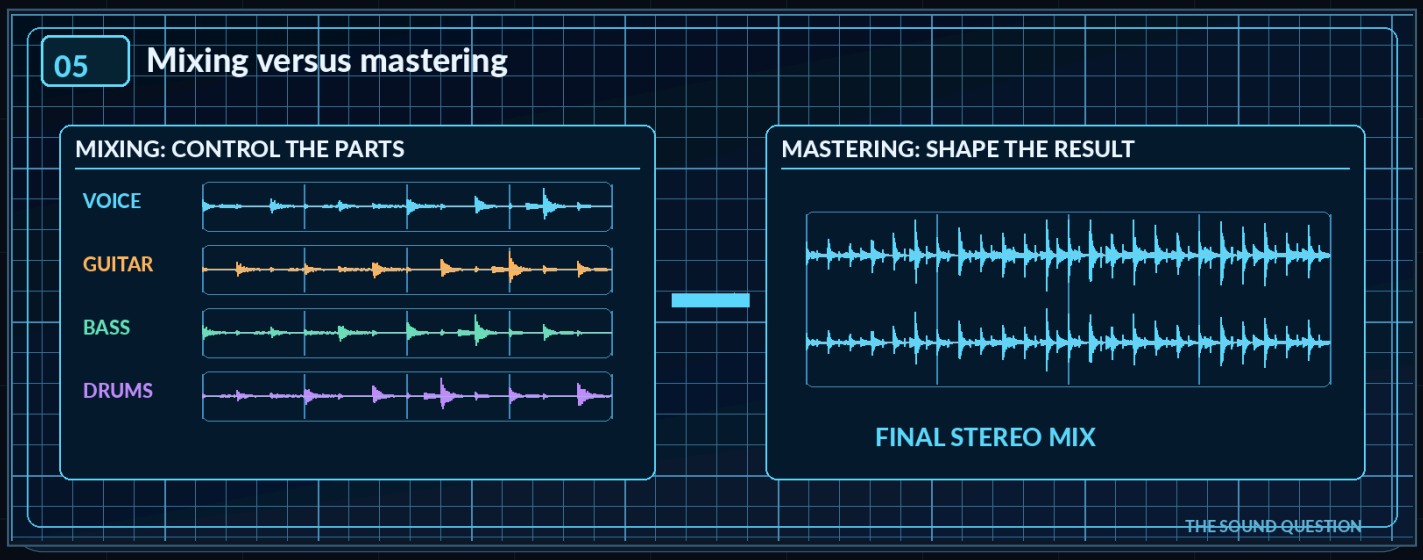
A finished mix can be mastered more dynamically or pushed to a denser average level. The original performance remains, but the relationship between quieter sections and peaks can change.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

05 / MASTERING

# Mixing and mastering are not the same job

Two stages, two different sets of controls. The difference explains why a remaster may change a familiar recording.




### MIXING HANDLES THE PIECES

With separate tracks available, an engineer might turn the guitar down without touching the vocal, pan a keyboard, or adjust the sound of one drum. That is a very different degree of control from adjusting a finished stereo mix.

### MASTERING HANDLES THE COMPLETED RELEASE

Mastering often works from the approved mix. The engineer may adjust overall tone and loudness, handle peaks, make songs sit consistently together, and prepare suitable delivery versions. A remaster may sound different even when nobody recorded another note.

### A REMIX IS ANOTHER THING ENTIRELY

A remix can revisit the individual recorded parts and rebuild their relationships. A remaster generally works from an existing mix. Labels on reissues can be confusing, so investigate which one you actually have.

**KEEP THIS IN MIND**

When comparing two editions of an album, first establish whether they use the same mix and master.

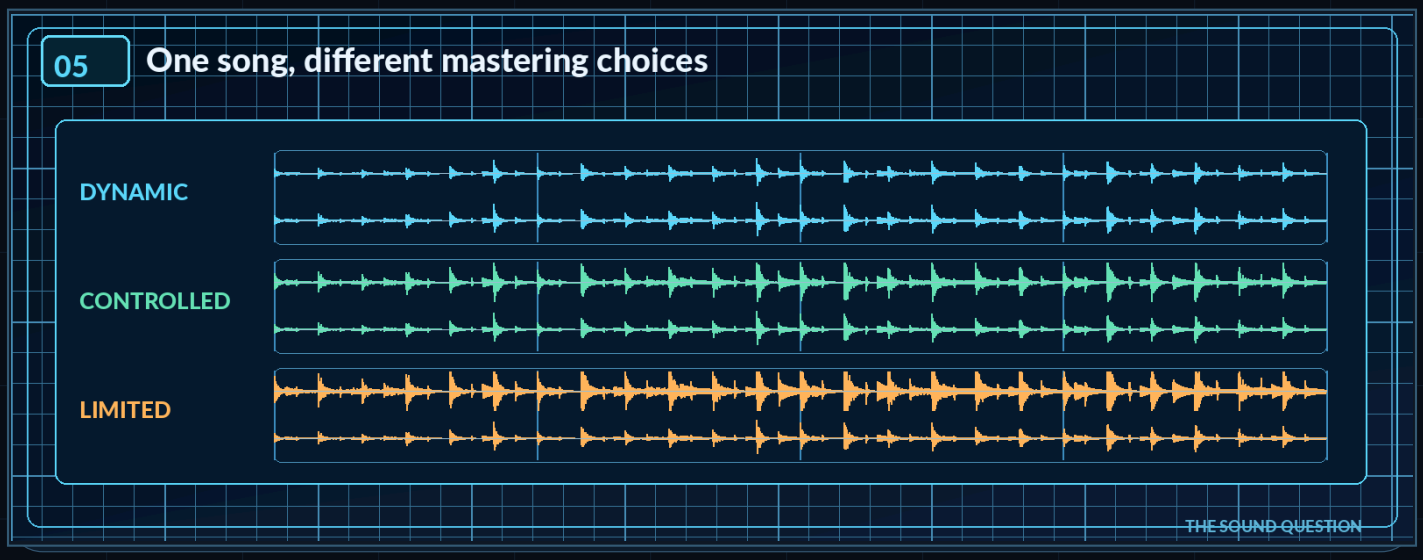
**EXPLORE THE LESSON ONLINE**

Mastering and dynamic range

05 / MASTERING

# The same song can have different punch

More apparent loudness does not guarantee that a recording feels more powerful, more detailed or more enjoyable.




### WHAT A LIMITER CHANGES

A limiter is a strong form of level control. It can hold the highest peaks down so the rest of the recording can be made louder. Used heavily, it can make drum hits stand out less from the music around them.

### WATCH THE PEAKS, BUT LISTEN TOO

Two waveform drawings can look very different without telling you whether either mastering is preferable. Loudness, frequency balance, clip damage, arrangement and playback level all matter.

**FROM THE CURATOR'S NOTES**

*I've spent time comparing different editions of albums I know well, including Tool recordings. A waveform or loudness reading can give me useful clues, but it doesn't tell me by itself whether I'm hearing a new master, a level-adjusted copy or a different mix. The recording's origin matters.*

### COMPARISONS NEED EQUAL LOUDNESS

A louder version often draws attention immediately. Match the playback level before deciding which has better detail, bass, impact or openness. Different masters are a poor way to test whether FLAC sounds different from MP3, because more than the format changed.

**KEEP THIS IN MIND**

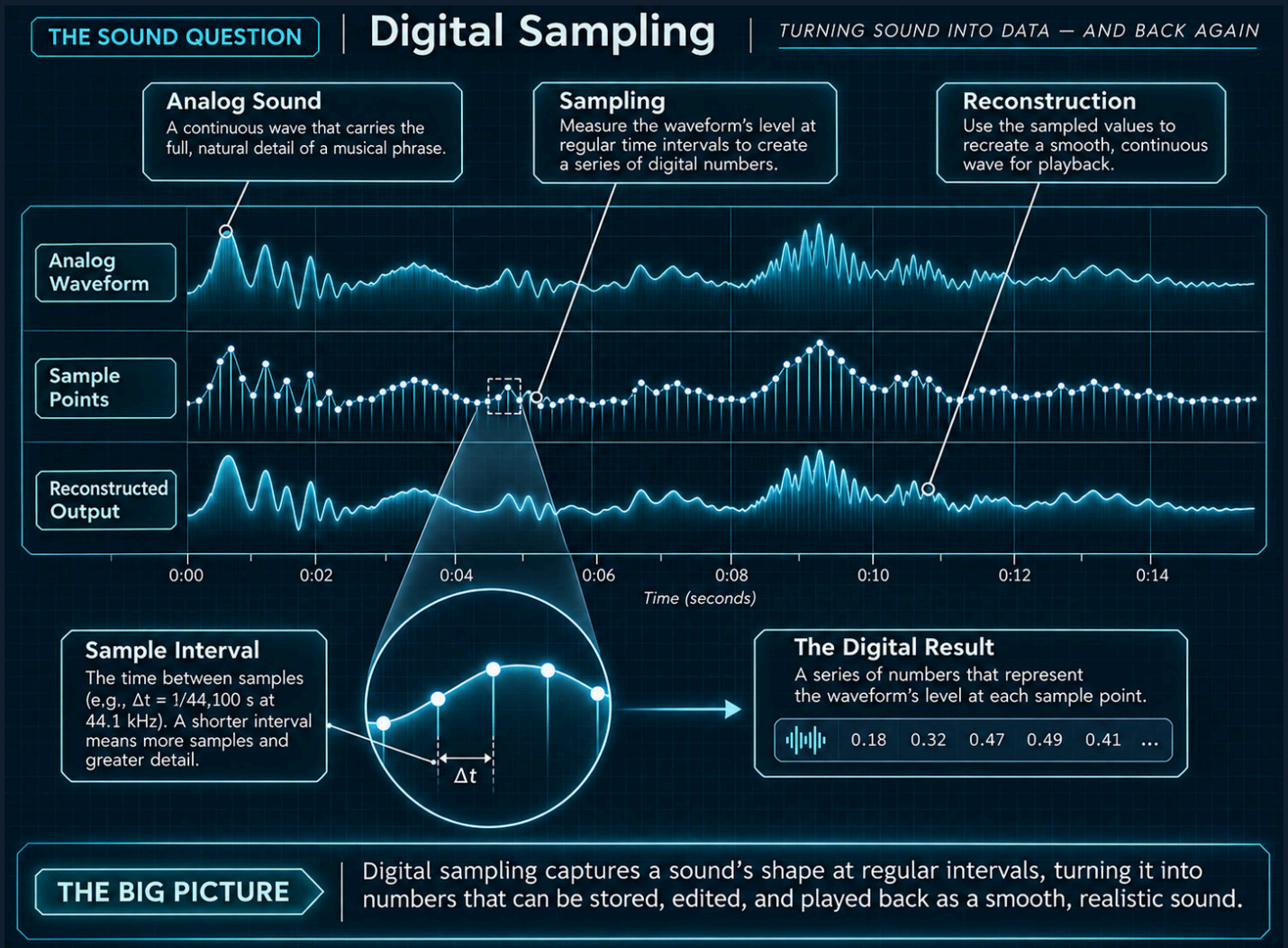
A newer remaster is a different edition, not an automatic upgrade. Listen at matched levels.

**EXPLORE THE LESSON ONLINE**

Mastering and dynamic range

06 / DIGITAL AUDIO

# From a waveform to numbers




## WHAT TO LISTEN FOR

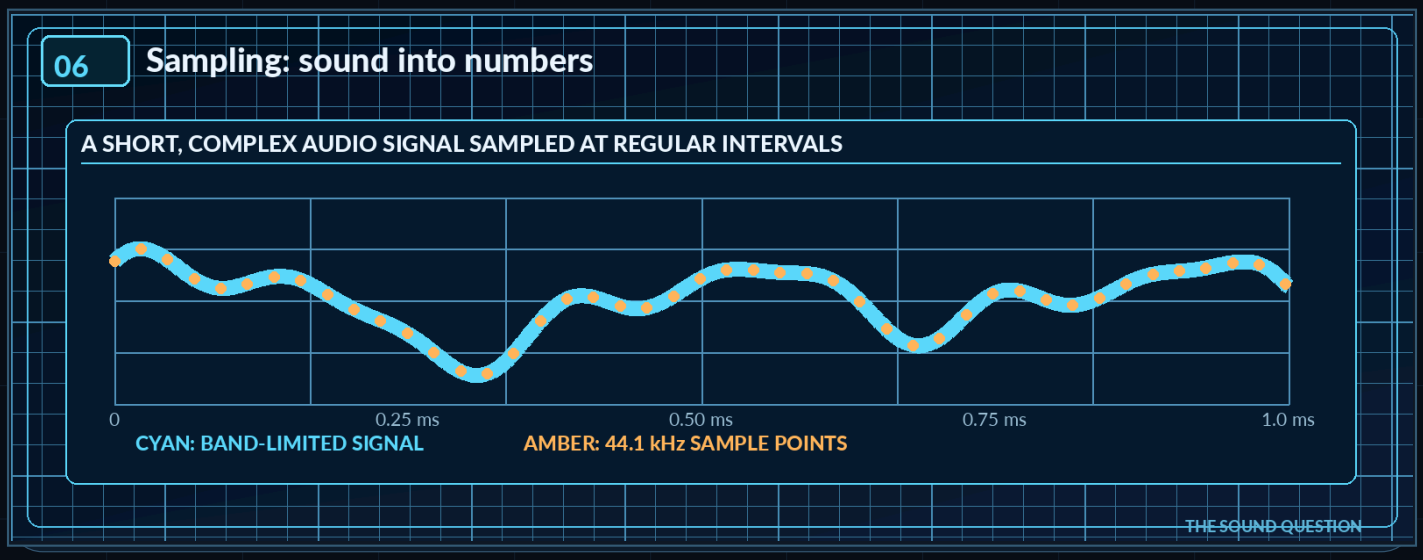
Digital sound is stored as regularly spaced sample values. Proper reconstruction produces a continuous analogue output; the sample dots are not the rough staircase sometimes shown in cartoons.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

06 / DIGITAL AUDIO

# Sample rate: how often we take a reading

A digital recorder stores regularly spaced readings of a changing signal. Sample rate says how many readings occur each second.




### FORTY-EIGHT THOUSAND TIMES PER SECOND

A sample rate of 48 kHz means 48,000 readings every second, per channel. A 44.1 kHz CD recording uses 44,100. These numbers describe time spacing, not how many musical details a human hears.

### WHY THERE IS A LIMIT

A correctly filtered digital system can represent frequencies below half its sample rate. That means a 48 kHz system has a theoretical upper frequency boundary of 24 kHz. Real converters use filters and do not necessarily reach that boundary with a flat response.

### DOES 192 KHZ SOUND FOUR TIMES BETTER?

No such conclusion follows. Higher rates can help in some recording, processing or filtering tasks, but a larger playback rate alone does not establish that a finished recording sounds better or contains genuine extra audible content.

**KEEP THIS IN MIND**

Sample rate sets a frequency boundary. It does not act as a universal sound-quality score.

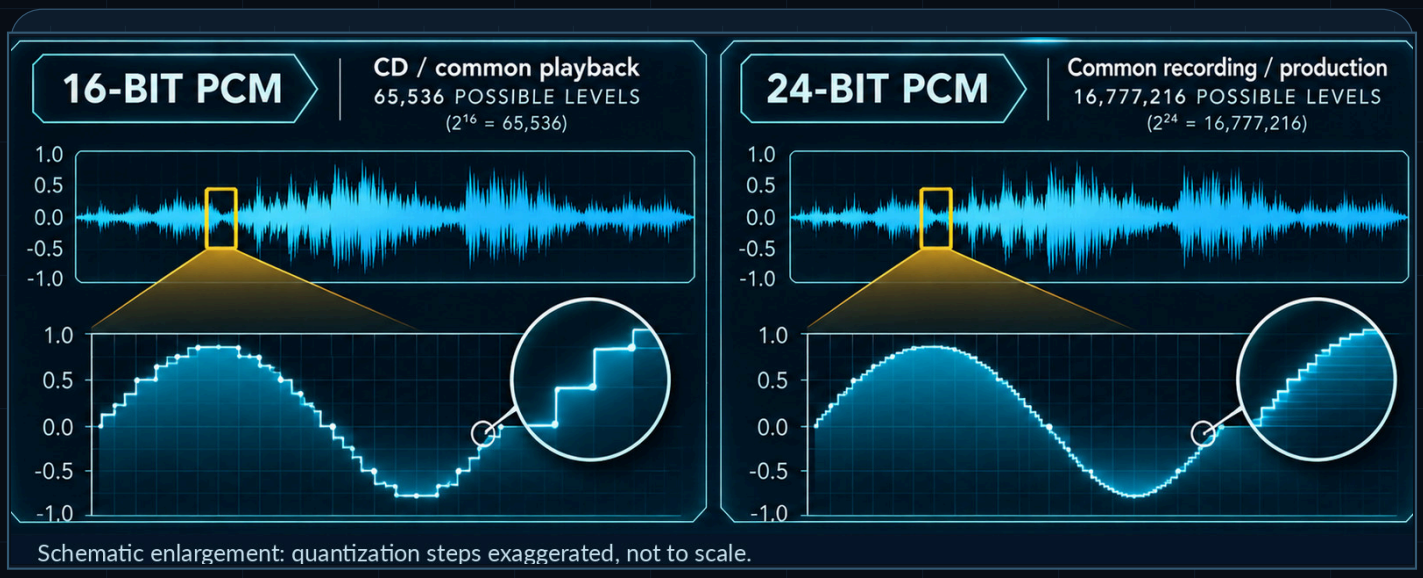
**EXPLORE THE LESSON ONLINE**

Sample rate

06 / DIGITAL AUDIO

# Bit depth: a more precise ruler

Bit depth describes the available steps for representing the height of a digital audio sample.




Schematic enlargement: quantization steps exaggerated, not to scale.

## IMAGINE MEASURING WITH A RULER

If your ruler only marks whole inches, you must round each measurement. Smaller marks let you record a more precise number. Audio bit depth works similarly: it reduces the error caused when each reading must fit a stored number.

## WHAT 16-BIT AND 24-BIT MEAN

Standard 16-bit PCM has 65,536 possible sample values. At 24-bit, there are 16,777,216. That is useful in recording because very quiet signals can be represented with less quantization noise. It does not create new instruments or improve a poor mix.

## DO NOT CONFUSE IT WITH MUSICAL DYNAMICS

Bit depth affects the technical noise floor and the recording process; the emotional rise and fall of a song depends on much more. A cleanly produced 16-bit consumer release can be excellent. A 24-bit label does not guarantee a better master.

**KEEP THIS IN MIND**

More bits allow finer stored levels. They do not automatically make music more expressive.

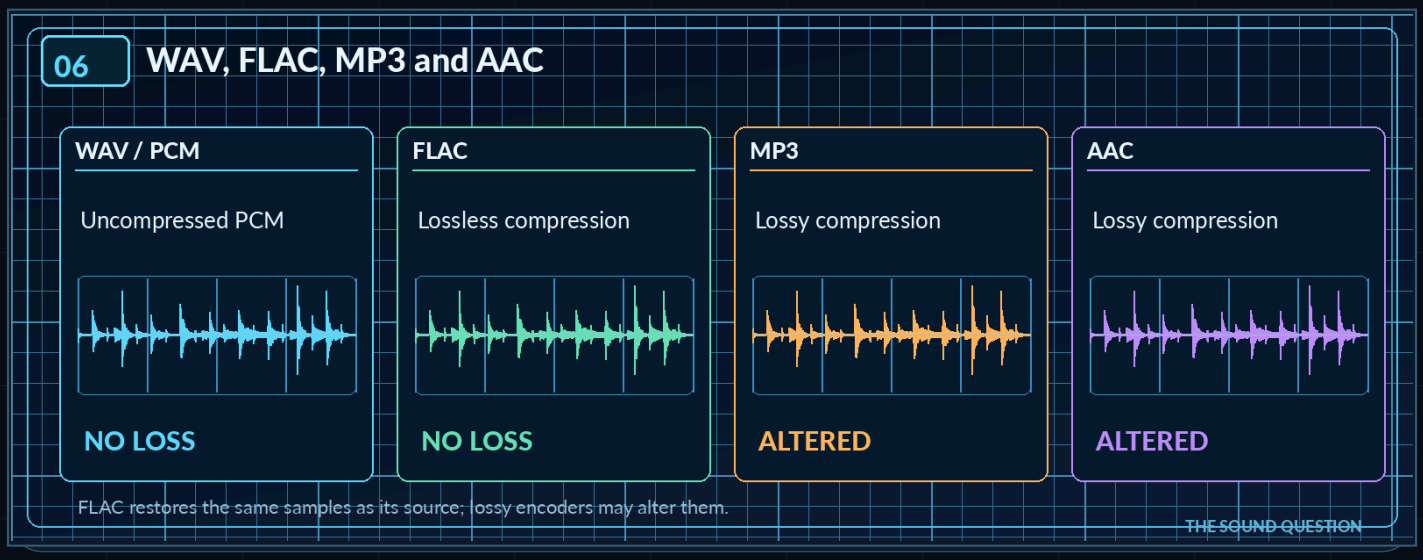
**EXPLORE THE LESSON ONLINE**

Bit depth

06 / DIGITAL AUDIO

# WAV, FLAC, MP3 and AAC

File formats answer different questions. Some preserve the sample data; others make a smaller approximation.




### PCM AND WAV

PCM is a way of representing audio as sample numbers. A WAV file commonly carries PCM data, although WAV is a container and can hold other encodings too. Ordinary stereo audio CDs use 16-bit, 44.1 kHz PCM.

### FLAC IS LOSSLESS

FLAC compresses audio data without discarding the information needed to restore the original encoded samples. A FLAC file can be smaller than an uncompressed WAV without being a lower-quality version of that particular PCM source.

### MP3 AND AAC ARE LOSSY

These formats reduce the data required partly by omitting or approximating information. Artifacts may be audible depending on music, encoder, setting and listener. A 128 kb/s MP3 is not the same proposition as a carefully encoded high-bitrate file.

**FROM THE CURATOR'S NOTES**

*I have noticed differences between some MP3 files and lossless copies in my own listening, especially at lower MP3 bitrates. At higher bitrates, the differences seem much less obvious. That's a reason to test using the same master and matched volume, not proof that I could always identify the formats in a blind test.*

### THE BIGGER TRAP

If one file came from a different master, a format comparison proves very little about the codec. The source material must be the same.

**KEEP THIS IN MIND**

Compare files derived from the same mastered source before making a claim about the format itself.

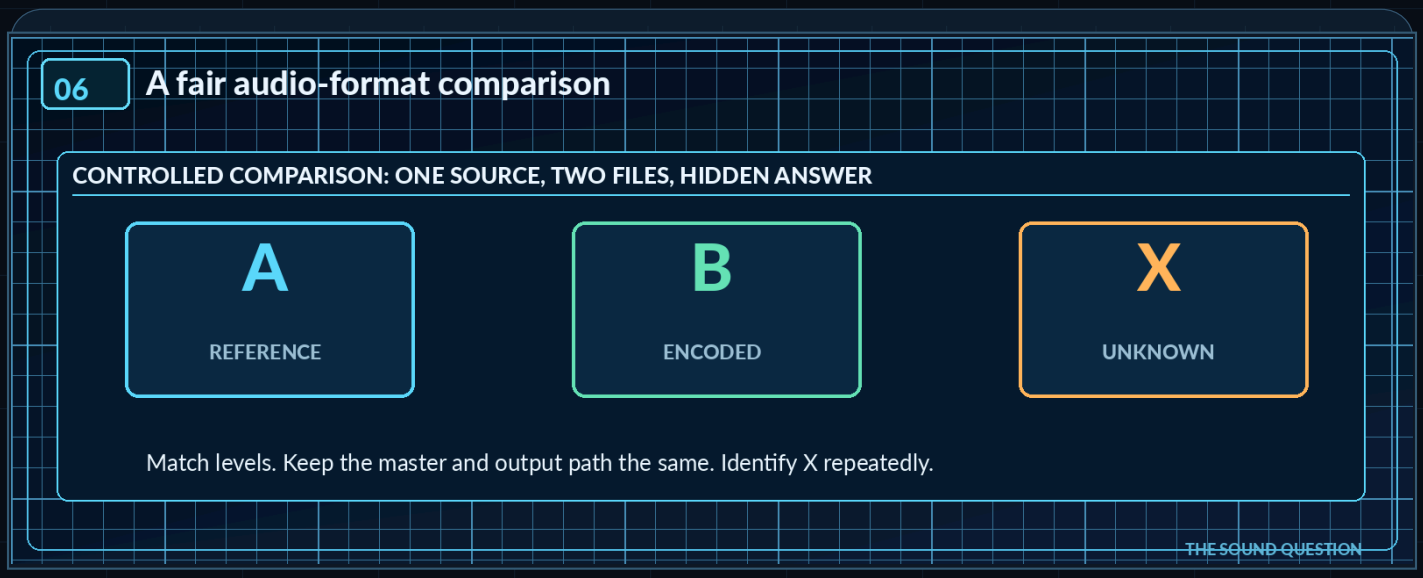
**EXPLORE THE LESSON ONLINE**

Lossy and lossless audio

06 / DIGITAL AUDIO

# How to compare audio formats fairly

A convincing comparison isolates what you actually want to test rather than changing several things at once.




### USE ONE ORIGINAL MASTER

Encode a lossless source into the test format and keep the original as the reference. Confirm that the player is not using different equalizer settings, sound enhancements, loudness normalization or output paths between them.

### MATCH LEVEL, THEN HIDE THE ANSWER

Make sure the versions play at the same level. In an ABX test, A and B are known examples and X is secretly one of them. Repeated correct identifications can provide evidence that the listener can tell them apart under those conditions.

### DETECTION IS NOT PREFERENCE

Recognizing a difference is not the same as liking it. Failing to identify a difference in one test does not prove the digital files are identical or that no listener in any situation could hear it. It limits what the result supports.

**KEEP THIS IN MIND**

Good experiments answer narrow questions. That is a strength, not a weakness.

**EXPLORE THE LESSON ONLINE**
Lossy and lossless audio

**TRY THE LISTENING LAB**
ABX sound tests

07 / SOURCES

# A source is more than the disc or file

CD players, sound cards, turntables, tape decks and streamers can reach the same amplifier by very different routes.




### WHAT DOES EACH OUTPUT CARRY?

A CD transport may send digital data to a separate DAC. A complete CD player usually also has analogue line outputs. A computer sound card or an external USB DAC can perform the conversion. A tape deck supplies an analogue signal taken from the tape or its input monitor.

### VINYL HAS ITS OWN EXTRA STEP

The cartridge creates a small electrical signal that normally requires a phono stage. That stage boosts the signal and applies the matching playback equalization used with standard records. Connecting a normal cartridge directly to an AUX input usually produces a very quiet, tonally wrong result.

### DO NOT JUDGE A FORMAT BY A SLOGAN

Vinyl is not automatically warm, and digital is not automatically cold. The master, cartridge, phono stage, DAC, noise, distortion and level can all contribute to what you hear.

**KEEP THIS IN MIND**

Know whether an output is phono, analogue line level or digital before plugging it into an amplifier.

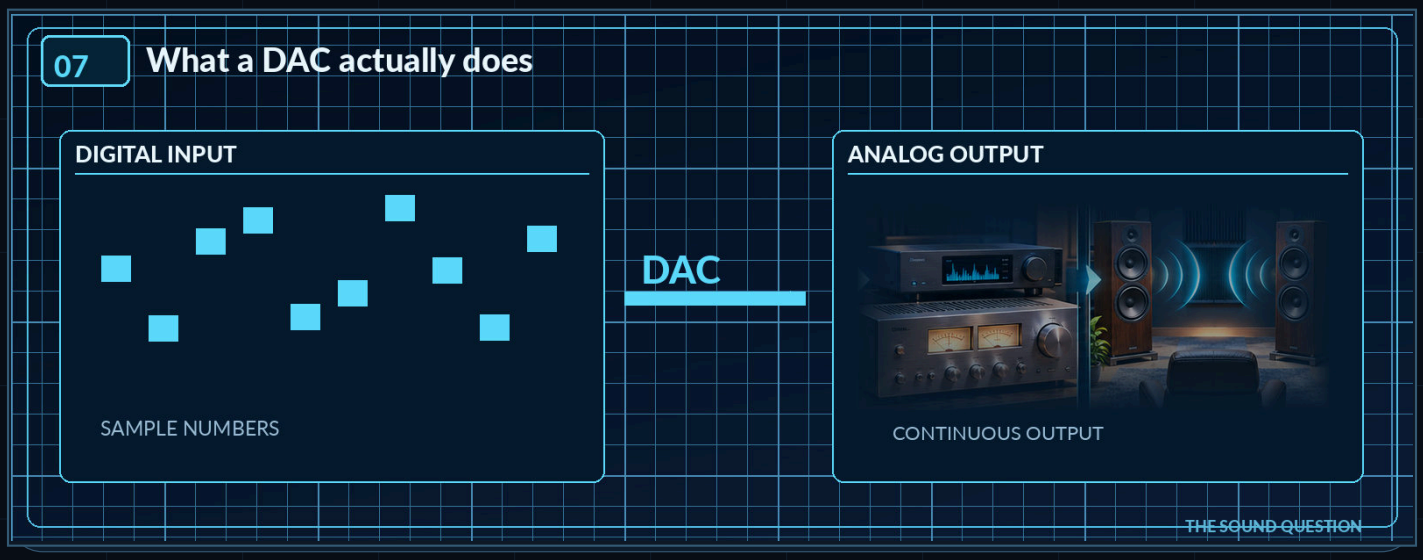
**EXPLORE THE LESSON ONLINE**

Playback sources and connections

07 / SOURCES

# What does a DAC actually do?

A digital-to-analogue converter turns sample numbers into a continuously varying electrical signal suitable for further amplification.




### CONVERSION IS ONLY THE START

A DAC includes filtering and an analogue output stage. Real devices can differ in noise, distortion, maximum output level, channel balance, filtering and behaviour when connected to other equipment.

### A NOISE FIGURE NEEDS CONTEXT

Signal-to-noise ratio compares the reference signal with background noise under a specified measurement method. A DAC rated at 120 dB SNR has a larger measured separation between its reference signal and noise than one rated at 100 dB SNR, **if the reference and test conditions really match**. That does not establish an audible improvement in an actual room.

### THE PRACTICAL QUESTIONS

Does it have the connections you need? Is its output compatible with the next device? Are its noise and distortion acceptably low at the levels you use? Can you change the digital filter, and do measurements show a relevant difference?

**KEEP THIS IN MIND**

A prestigious DAC chip or high sample-rate logo does not substitute for actual device performance.

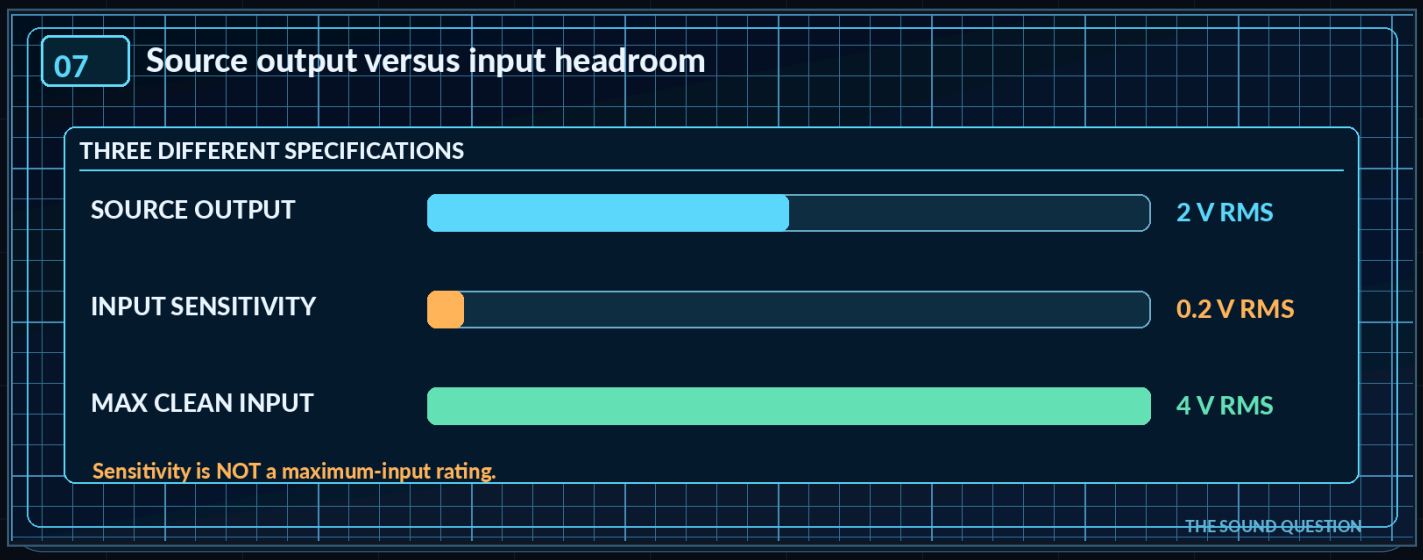
**EXPLORE THE LESSON ONLINE**

DAC specifications

07 / SOURCES

# Why more output voltage is not always bad

A player can output 2 volts while an amplifier says it needs only 0.2 volts. That does not automatically mean overload.




### SENSITIVITY AND MAXIMUM ARE DIFFERENT

Input sensitivity tells you roughly how much signal is needed to reach a stated amplifier output under specific conditions. Maximum clean input tells you how much signal the relevant input path can accept before it distorts. The two numbers answer different questions.

### VOLUME CONTROLS COMPLICATE THINGS

A volume control usually reduces signal level somewhere in the amplifier, but where it sits relative to the first gain stage matters. A source that is much higher than the input sensitivity may still be perfectly compatible, or it may overload an early stage if the maximum input level is low.

### AN HONEST EXAMPLE

If a source outputs 2.0 V RMS, an amplifier with a verified 4.0 V clean input limit has margin at that test point. An amplifier whose input limit is only 1.0 V could be overloaded. If the limit is unknown, the right conclusion is unknown.

**KEEP THIS IN MIND**

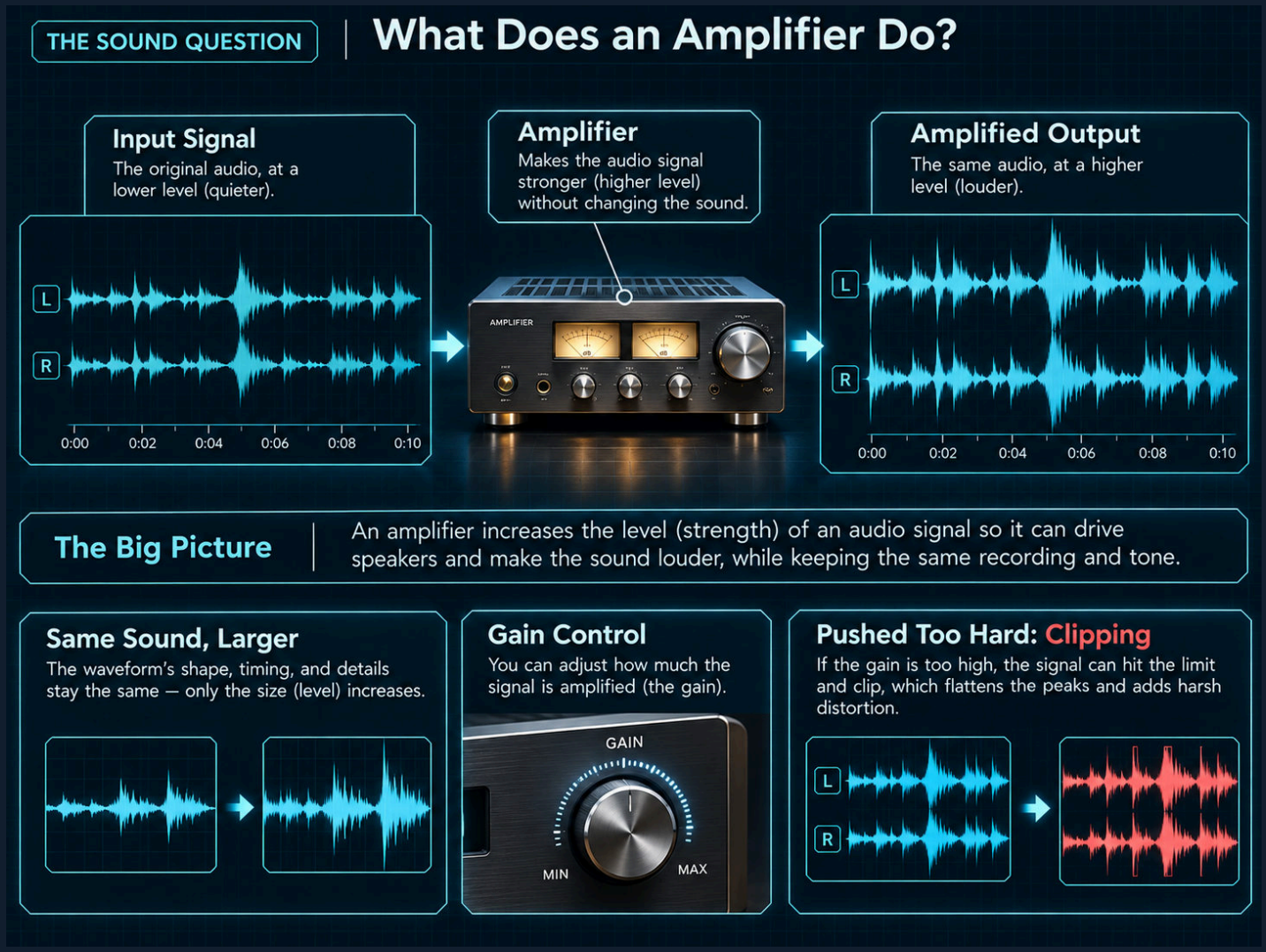
Do not assume that a stronger source is cleaner or distorted. Check the maximum clean input where available.

**EXPLORE THE LESSON ONLINE**

Source output and amplifier inputs

08 / AMPLIFIERS

# The same signal, more power




## WHAT TO LISTEN FOR

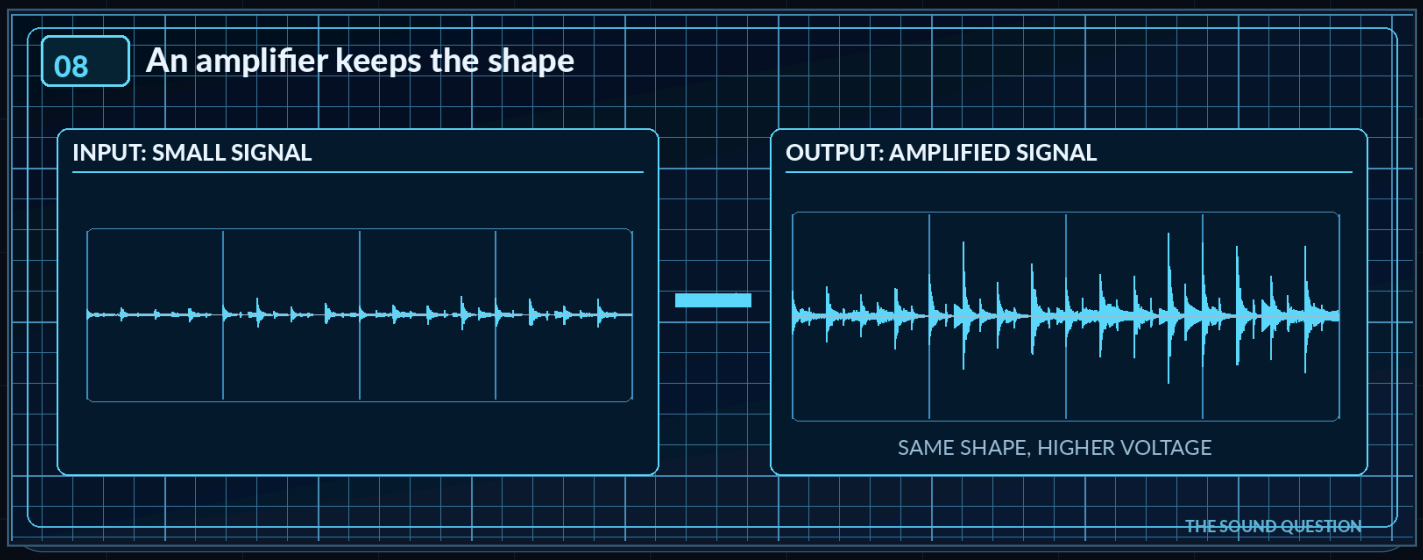
A linear amplifier makes the signal larger without deliberately changing its shape. Follow the input and output waveforms before exploring power, speaker loads, distortion and headroom.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

08 / AMPLIFIERS

# What an amplifier is supposed to do

An amplifier takes a relatively small electrical music signal and supplies the voltage and current needed by a loudspeaker.




### KEEP THE SHAPE

Ideally, the output is a larger but otherwise faithful copy of the input. Real amplifiers are limited by their power supply, components, temperature, load, gain stages and protective circuitry. Their behaviour can change as they approach those limits.

### VOLTAGE AND CURRENT ARE PARTNERS

Voltage is the electrical push available across a load. Current is the flow the amplifier must supply. Watts describe electrical power. The load determines how much current a given voltage requires, so two speakers can challenge an amplifier in different ways.

### GOOD AT ONE LEVEL DOES NOT GUARANTEE EVERY LEVEL

An amplifier may measure cleanly at a modest output and distort more when pushed. But two amplifiers with different rated power can also be audibly indistinguishable when both work comfortably inside their limits, driving the same speakers at the same actual listening level.

**KEEP THIS IN MIND**

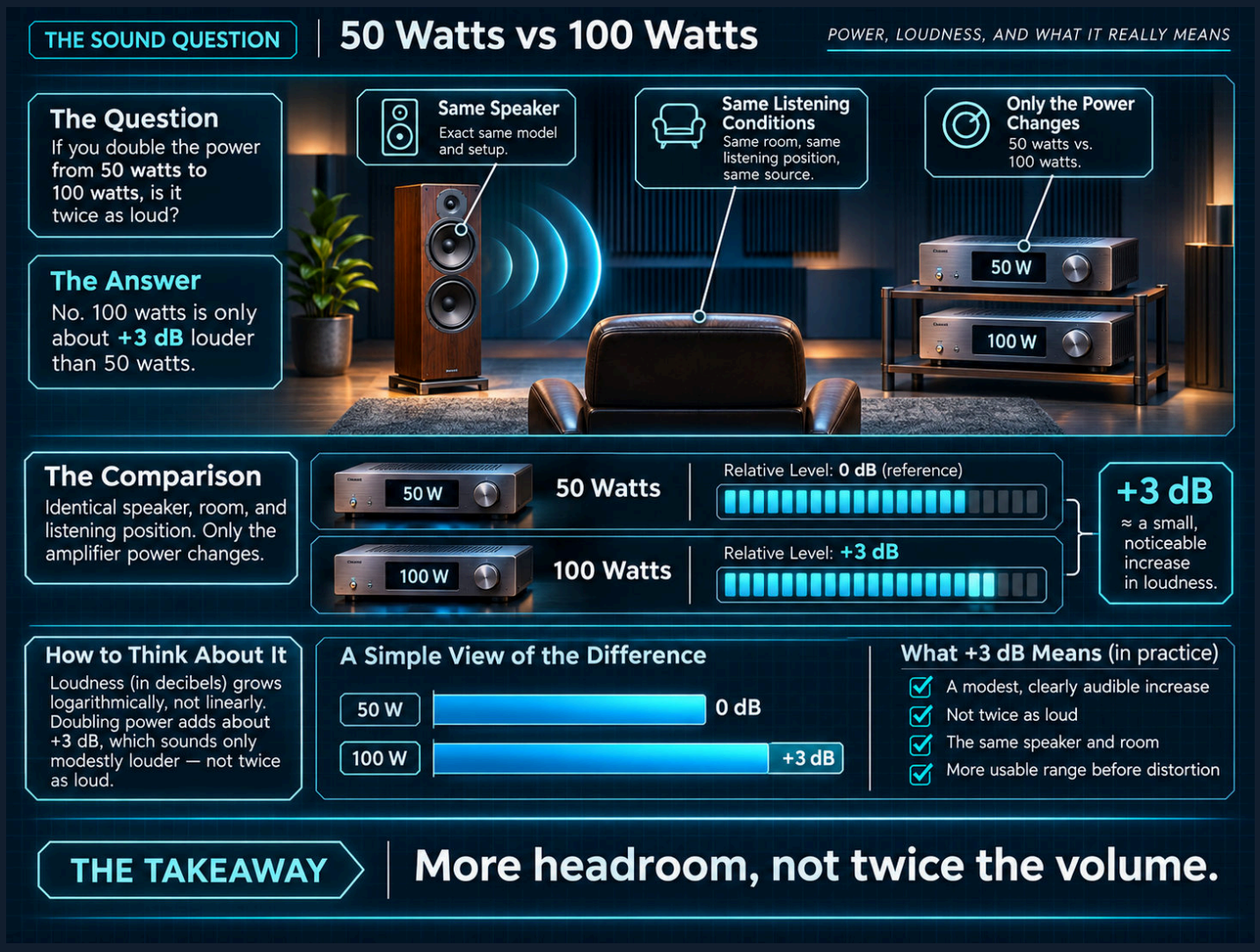
Judge an amplifier by what it can deliver into your speakers at the level you use, not just the largest number on its faceplate.

**EXPLORE THE LESSON ONLINE**

Amplifier power and headroom

08 / POWER EXPLAINED

# 50 watts is not half as loud




## WHAT TO LISTEN FOR

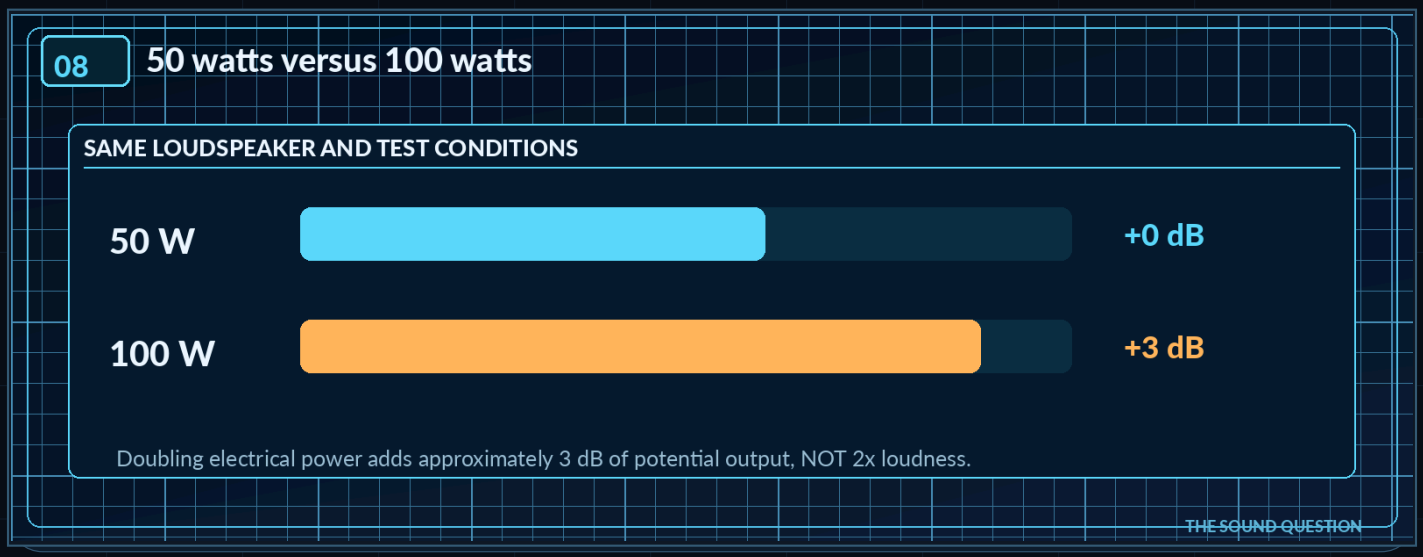
With the same speaker under comparable conditions, doubling electrical power offers about 3 dB more potential output. That is a useful increase, but not twice the perceived loudness.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

08 / AMPLIFIERS

# Why twice the watts is not twice as loud

Electrical power and perceived loudness use different scales. Doubling the wattage adds about 3 dB of potential output with the same speaker under ideal conditions.




### THREE DECIBELS IS USEFUL, NOT MIRACULOUS

Moving from 50 W to 100 W adds about 3 dB to the theoretical maximum sound level if the speaker remains equally efficient and the amplifier can really deliver it. Ten times the power adds 10 dB. Neither change guarantees the same impression of loudness for every musical passage.

### SPEAKER SENSITIVITY CHANGES THE CALCULATION

A speaker producing more sound from the same test input needs less electrical power for the same output. Listening distance and room reflections also matter. A power figure alone cannot tell you how loud a pair of speakers will play at the sofa.

### READ THE FULL RATING

Look for load impedance, frequency range, distortion threshold, continuous versus brief output, and number of channels driven. A single impressive wattage figure with vague test conditions is hard to compare fairly.

**KEEP THIS IN MIND**

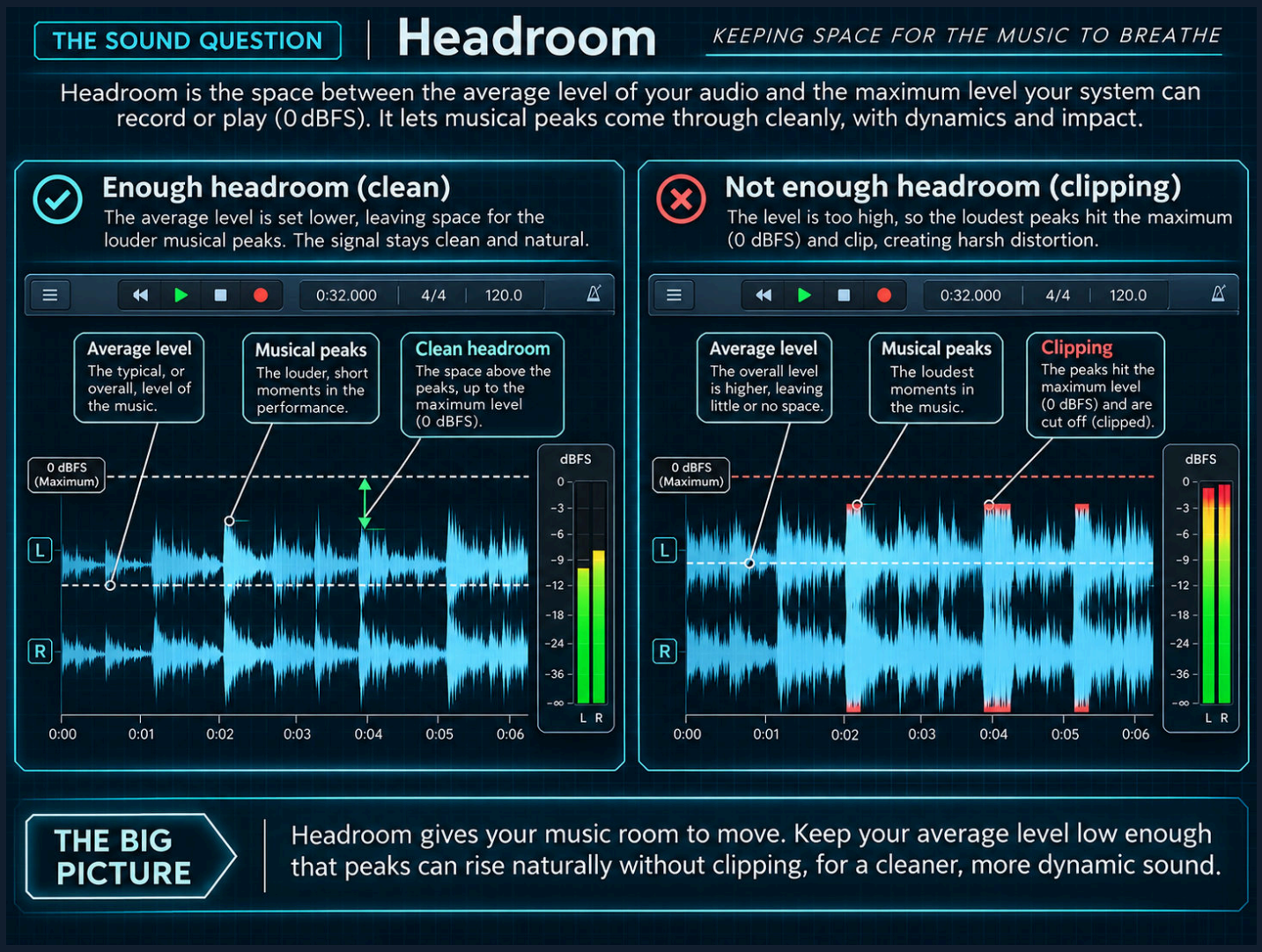
Buying twice the watts mainly buys additional potential headroom; it is not an automatic doubling of listening volume.

**EXPLORE THE LESSON ONLINE**

Amplifier power and headroom

08 / HEADROOM

# Leave room for musical peaks




## WHAT TO LISTEN FOR

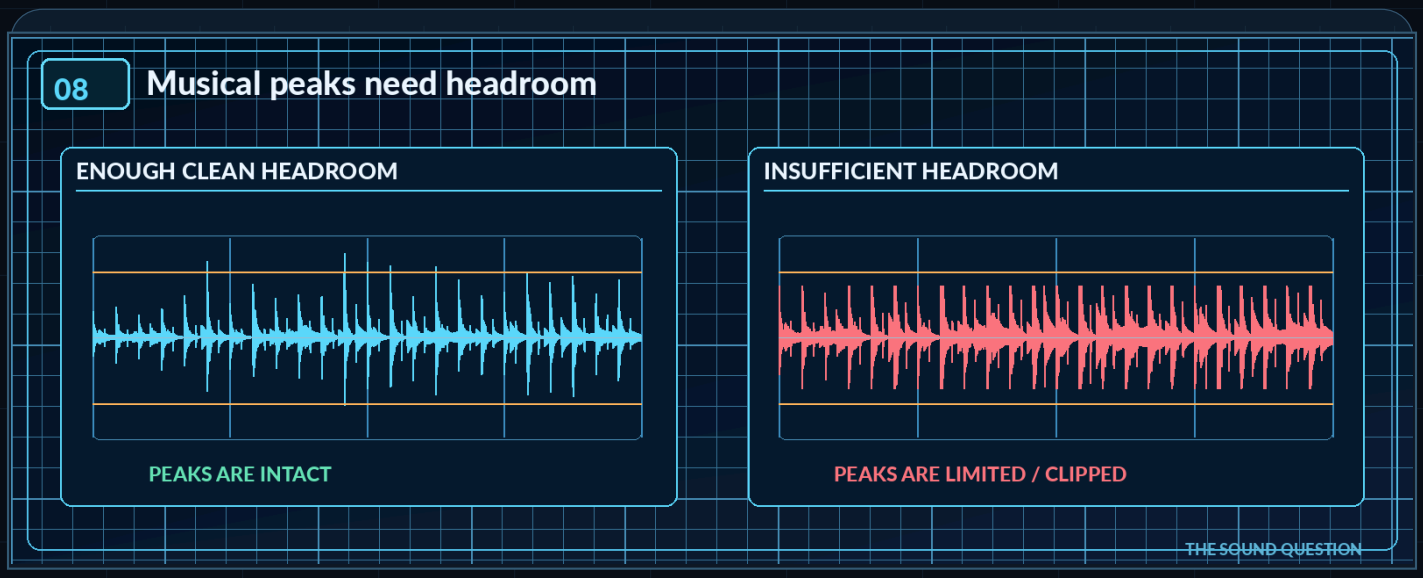
Dense average level is not the same as a sudden musical peak. An amplifier and speaker system need enough clean output range to reproduce both, especially when music becomes demanding.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

08 / AMPLIFIERS

# Headroom: space for the next big drum hit

Music can be quiet on average and still demand a large short-lived burst of power.




## THE AVERAGE IS NOT THE PEAK

A drum strike can momentarily rise far above the surrounding sound. An amplifier needs room to reproduce that burst cleanly. If the requested output exceeds its available range, the waveform can be altered or clipped.

## WHY THE SPEAKER MATTERS

A loudspeaker can also compress its output, distort or approach its mechanical or thermal limits. More amplifier power does not guarantee that the speaker will keep getting louder cleanly. The amplifier and loudspeaker must be considered together.

**FROM THE CURATOR'S NOTES**

With my Panasonic SA-HE100 and Paradigm speakers, I noticed that dense recordings could lose separation as I turned the volume up. I couldn't tell whether the amplifier, speakers, room or another part of the system was responsible. That experience made me want to understand the equipment a little better.

## KEEP THE NUMBERS GROUNDED

A calculation based on advertised sensitivity and wattage is a starting estimate, not a measurement in your room. It needs realistic assumptions about listening distance, how loud the peaks are, and how the speaker changes with power and frequency. Our System Check tool makes those assumptions explicit.

**KEEP THIS IN MIND**

It is possible to need plenty of power for brief peaks while using only a little on average.

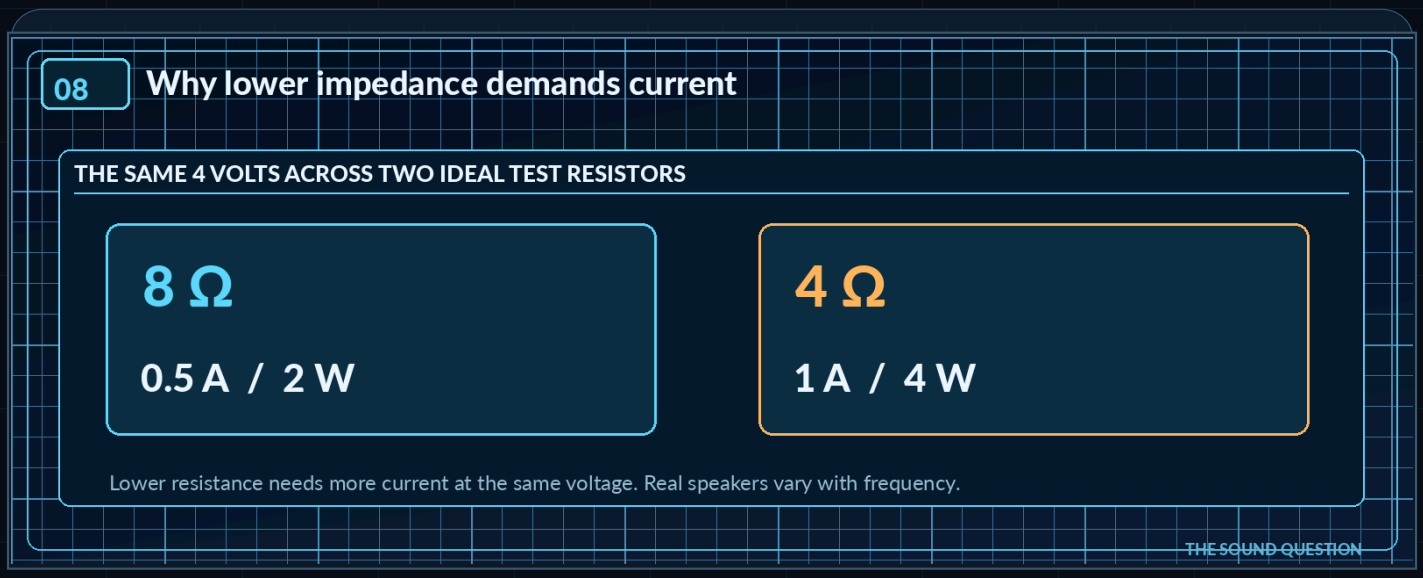
**EXPLORE THE LESSON ONLINE**

Amplifier power and headroom

08 / AMPLIFIERS

# Four ohms, eight ohms and current

Speaker impedance tells us about the electrical load, but the printed number is only part of the story.




## START WITH A SIMPLE EXAMPLE

Imagine the amplifier is producing a 4 V RMS test signal. Connected to an ideal 8-ohm **resistor**, that means 0.5 A of current and 2 W of power. Keep the voltage at 4 V RMS but change to an ideal 4-ohm resistor: now it needs 1 A and receives 4 W. Same electrical push, twice the current. The amplifier has to supply that extra current. A real speaker is more complicated, and turning a volume knob to one position does not guarantee a particular voltage.

## REAL SPEAKERS KEEP CHANGING

A real speaker is not a single fixed resistor. Its impedance rises and falls across frequencies, and voltage and current can be out of step. That means a nominally 8-ohm design can still demand care at particular notes.

## PRACTICAL MATCHING

Check the amplifier manufacturer's supported speaker loads, especially when using several pairs. Do not assume an amplifier will double its 8-ohm rating into 4 ohms. Follow the manufacturer's specified speaker-load requirements; an impedance or protection switch cannot give an amplifier extra current capability.

**KEEP THIS IN MIND**

Lower ohms can demand more current. They are not a direct measure of louder or better sound.

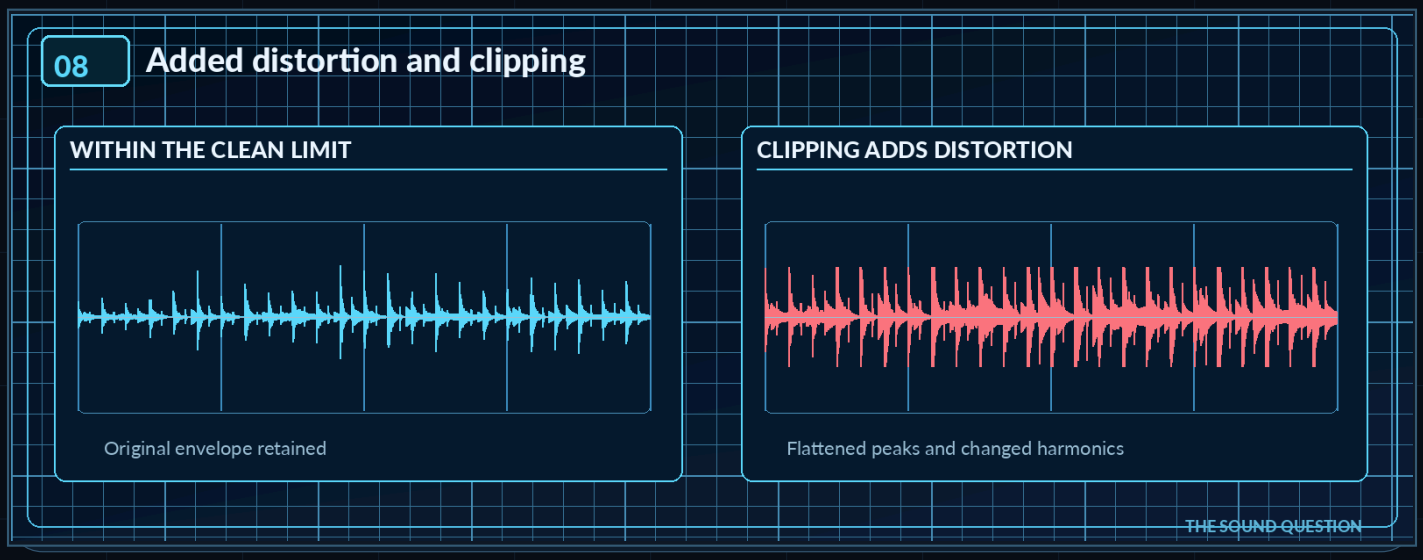
**EXPLORE THE LESSON ONLINE**

Ohm's law for audio

08 / AMPLIFIERS

# Distortion: sound that was not in the source

Amplifiers can add unwanted changes to a waveform, and the amount can vary with loudness, frequency and load.




### CLIPPING IS A FAMILIAR EXTREME

When an amplifier reaches its available voltage or current limit, peaks may flatten or otherwise deform. That adds new frequency content and can sound rough or harsh. Lesser distortion can occur before clipping; not all distortion is a hard flat-topped wave.

### WHAT DOES THD MEAN?

Total harmonic distortion estimates the energy in added harmonic components for a test tone under specified conditions. THD+N also includes measured noise in the result. A small number at 1 kHz and low power tells you little about what happens at high output or difficult frequencies.

### NUMBERS NEED EARS AND CONTEXT

Two products with different distortion measurements are not automatically audibly different. The distortion spectrum, amount, music, sound level and listener matter. If a spec does not state the test conditions, comparisons are unreliable.

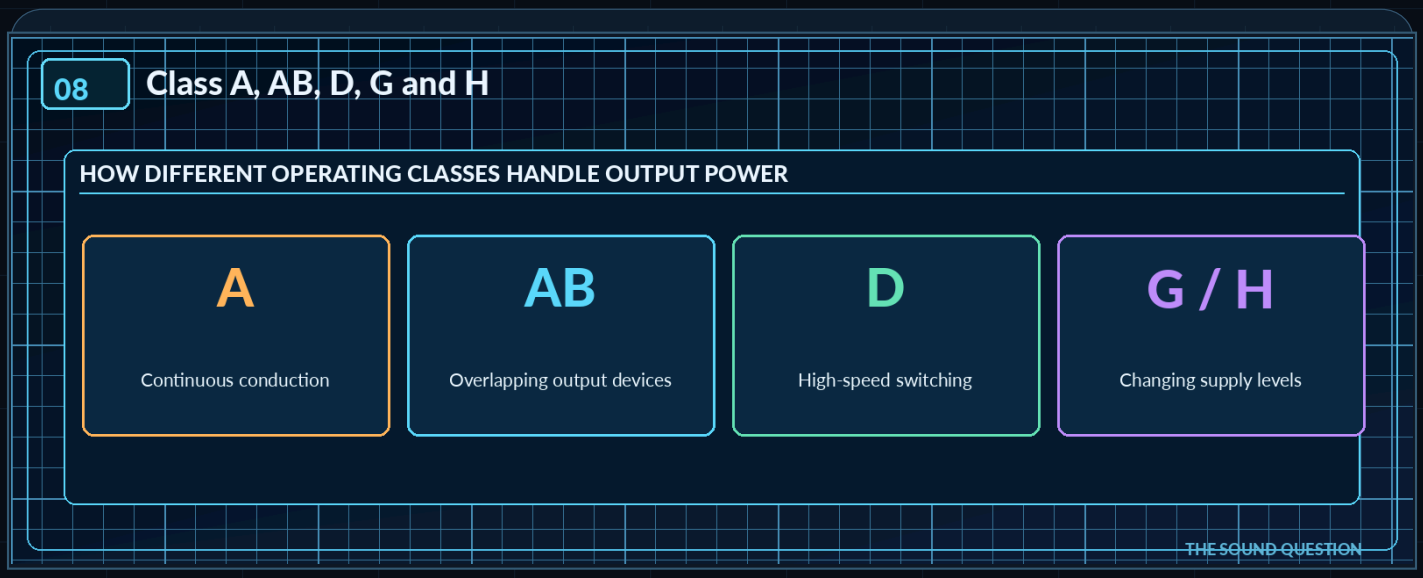
> **KEEP THIS IN MIND**
> A distortion rating is meaningful only with its power level, frequency, load and measurement conditions.

**EXPLORE THE LESSON ONLINE**
Amplifier distortion

08 / AMPLIFIERS

# Class A, AB, D, G and H

The amplifier class describes how parts of its output circuitry operate, not a guaranteed sound signature.




## CLASS A AND CLASS AB

In a conventional Class A output stage, the amplifying devices keep conducting throughout the signal cycle. That generally means considerable heat and power consumption even at idle. Class AB typically uses much less idle power. Two sets of output devices share the work, with a small overlap as the signal changes direction. **That overlap is there to reduce crossover distortion**, the error that can happen when one device hands over to the other. Class AB still needs good design and adjustment, but it can offer an excellent balance of low distortion, useful power and manageable heat. Either class can be implemented well or poorly.

> **FROM THE CURATOR'S NOTES**
>
> *My Yamaha A-720 has an Automatic Class A feature. That's a good example of why we need to look past a name on the front panel: it doesn't mean the output stage operates in Class A at every power level, or that the feature alone predicts the sound.*

## CLASS D

Class D uses fast switching and output filtering. It can provide high efficiency and useful power in smaller equipment. It does not mean the incoming audio is necessarily digital, and it does not automatically sound clinical or harsh.

## CLASS G AND H

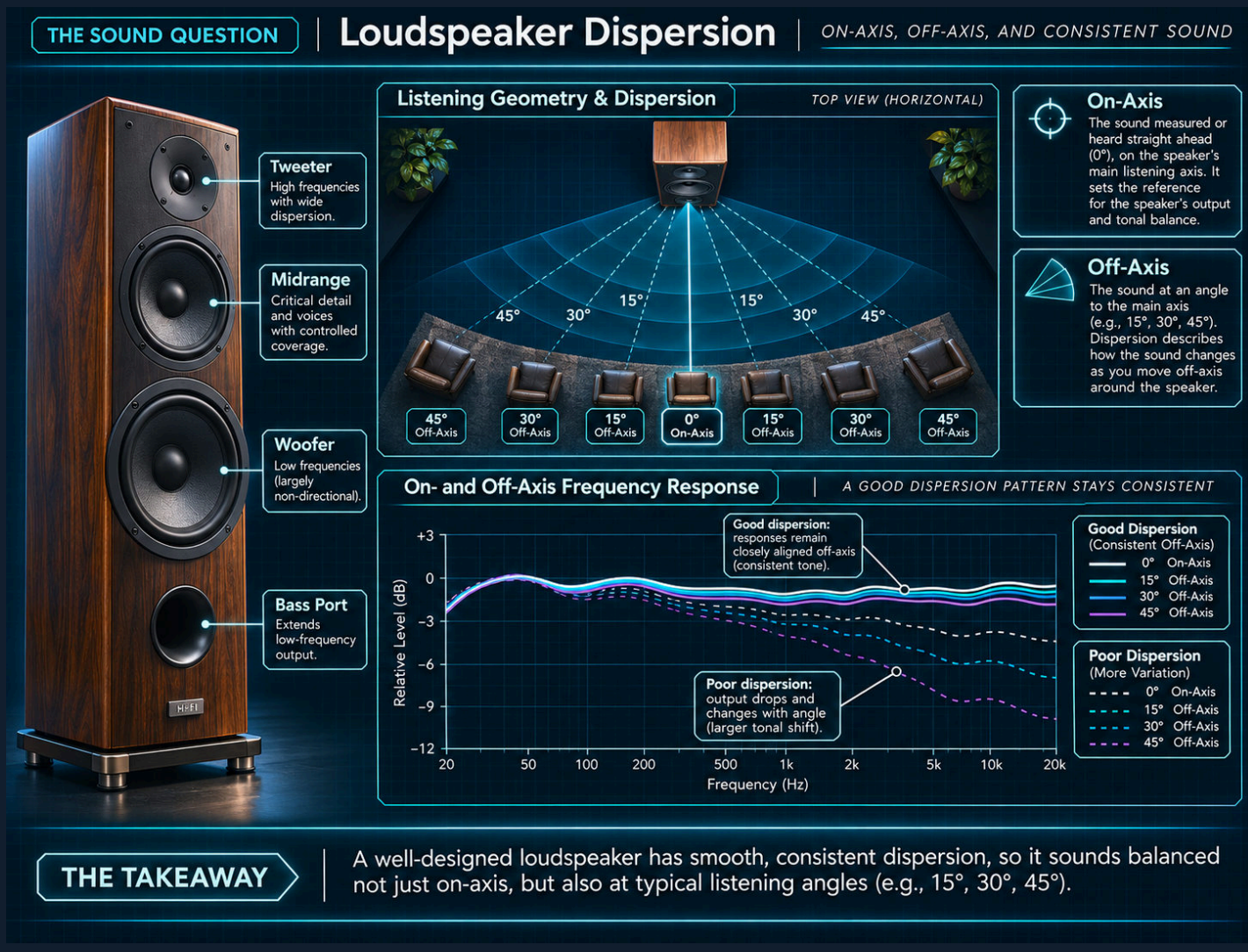
These vary their supply rails or available supply levels to improve efficiency under changing output demand. What matters at the speaker terminals is the finished product's measured behaviour. Also remember that MOSFET is a transistor type, not a rival operating class.

> **KEEP THIS IN MIND**
>
> Choose a design for performance, features, power, heat and reliability, not just the name of its class.

**EXPLORE THE LESSON ONLINE**
Amplifier classes

09 / LOUDSPEAKERS

# Sound changes with direction




## WHAT TO LISTEN FOR

The on-axis response is only one angle. A speaker also sends sound toward the walls and across the couch. Consistent off-axis behaviour helps explain why placement can change a stereo image.

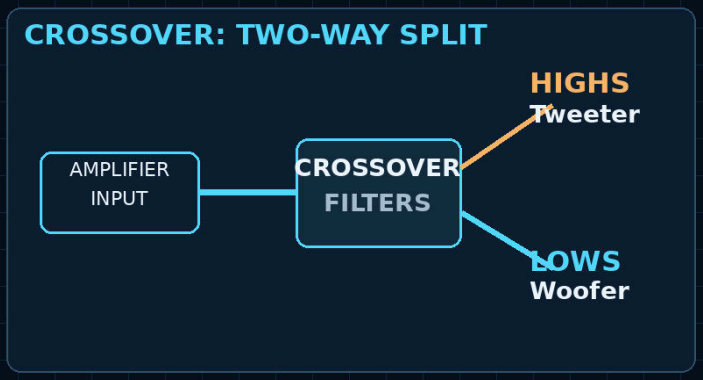
FOLLOW THE NEXT PAGES FOR THE EXPLANATION

09 / LOUDSPEAKERS

# The drivers share the music

A conventional loudspeaker uses moving drivers to turn an electrical signal into pressure waves in the air.

09 The drivers share the music






A crossover directs frequency bands to their intended drivers. Driver materials and crossover design both matter.

## WHO PLAYS WHAT?

A tweeter generally handles the high notes. A woofer or midwoofer handles lower frequencies. A three-way speaker often adds a separate midrange role. A **speaker crossover** divides the signal so the drivers can work together through their intended frequency ranges. It is unrelated to the *crossover distortion* discussed in amplifier design.

## TWO-WAY DOES NOT NECESSARILY MEAN TWO DRIVERS

The number of ways refers to main acoustic frequency bands or roles, not necessarily the number of visible drivers. Two speakers with the same number of visible drivers may use very different crossovers and behave differently.

### FROM THE CURATOR'S NOTES

*My old Cerwin-Vega D5s had a 12-inch woofer, a separate midrange and a horn tweeter. They could deliver drum hits and guitar riffs with a kind of direct, physical energy I loved. The Paradigm Phantoms I listen to now are a different experience: less about throwing the music at me, more about keeping the parts of the recording in balance. A driver list alone doesn't tell you how either speaker will present a song.*

## MATERIALS NEED CONTEXT

Soft fabric domes, aluminium, titanium and beryllium all have genuine engineering trade-offs. A costly material can help a designer reach a goal, but it cannot by itself predict smooth response, dispersion, distortion or enjoyment. The completed speaker is what should be judged.

### KEEP THIS IN MIND

Driver material is an ingredient, not a final report card.

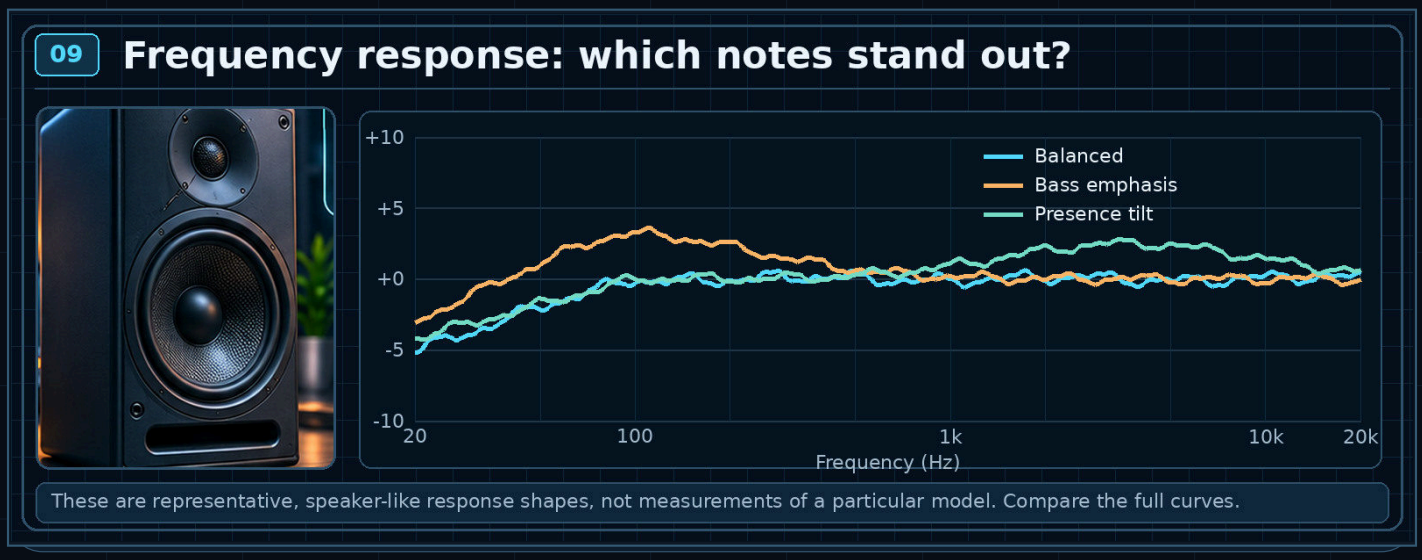
EXPLORE THE LESSON ONLINE

Speaker drivers and crossovers

09 / LOUDSPEAKERS

# Frequency response: which notes stand out?

The response curve describes how strongly a speaker reproduces different frequencies under a particular test setup.




### READ FROM LEFT TO RIGHT

Deep bass sits on the left, voices and most instruments occupy broad middle regions, and the top end is on the right. A higher line means that frequency region is stronger relative to the chosen reference; a lower line is weaker.

### FLAT, BRIGHT AND WARM

A fairly even response is a useful neutral starting point. A rise in upper frequencies may sound brighter or more forward. More lower-mid or bass energy can sound fuller or warmer. Different listeners may reasonably prefer different balances.

### ONE PRINTED RANGE IS INCOMPLETE

A specification such as 55 Hz-20 kHz (+/-3 dB) describes a claimed frequency span and tolerance, not the shape of the actual curve. It does not show peaks, dips, off-axis behaviour, distortion, maximum level or what your room will do.

**FROM THE CURATOR'S NOTES**

*The Yamaha A-720 and Paradigm Phantom v1s are the combination I keep coming back to when I want to really listen. Nothing seems to need an exaggerated boost to get my attention. I can follow the bass, guitar, vocals and drums without one constantly stepping all over another. That's what a fairly even tonal balance means to me in practice. My old Cerwins were more upfront and exciting in a different way, and I liked that too.*

**KEEP THIS IN MIND**

A smooth response curve often tells you more than a frequency-range label with no tolerance.

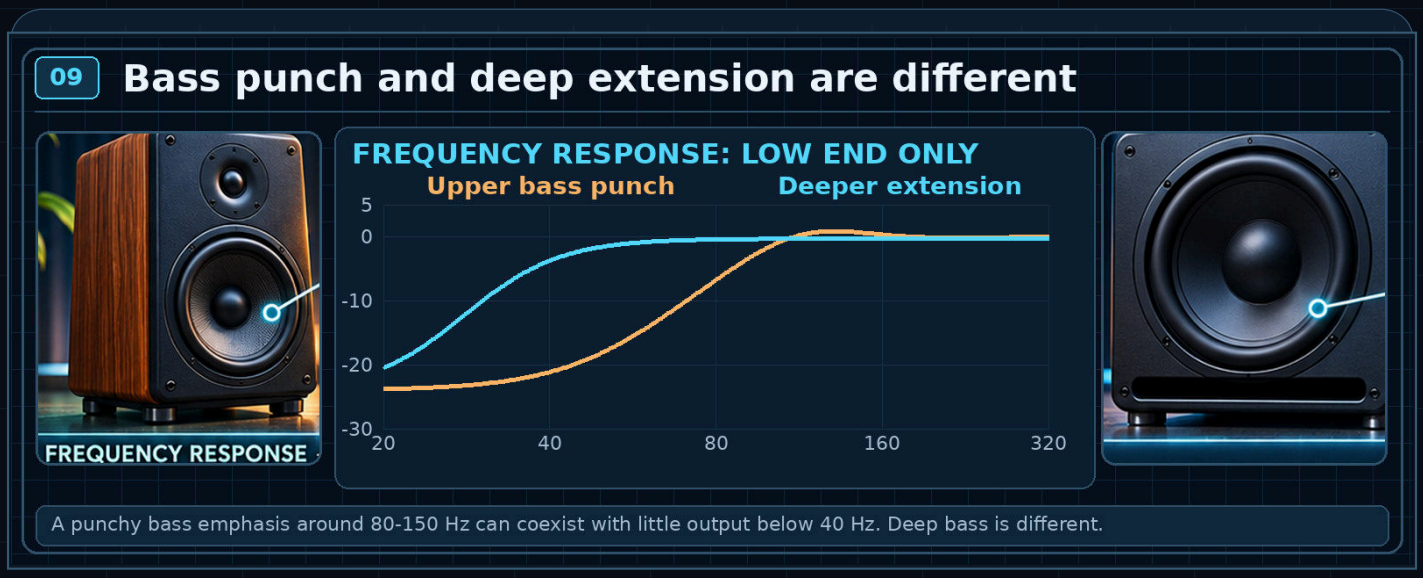
**EXPLORE THE LESSON ONLINE**

Speaker frequency response

09 / LOUDSPEAKERS

# Bass punch and bass extension are different

A speaker can feel forceful through upper bass yet lose much of the deepest content.




## FOLLOW THE ROLL-OFF

A bass specification such as 45 Hz at -6 dB tells you the response at one frequency relative to a reference. It does not mean sound stops below 45 Hz. The slope, output capability and room matter.

## WHY A LARGER BOX IS NOT ALWAYS ENOUGH

Cabinet size, driver area, tuning, excursion limits and electronic processing all influence the result. A ported cabinet can produce more output in a chosen lower range, but it brings its own tuning and behaviour below that range. A sealed design often has a gentler low-frequency roll-off below its tuning region, although the actual result depends on the design and processing.

## SUBWOOFERS ARE A TOOL

A properly integrated subwoofer can extend low-frequency output and sometimes ease the burden on main speakers when they are high-pass filtered. Placement, crossover level, timing and room modes affect the outcome. Adding a sub without adjusting its integration can make bass worse.

**KEEP THIS IN MIND**

A bump around punchy bass notes does not prove a speaker can reproduce very deep bass cleanly.

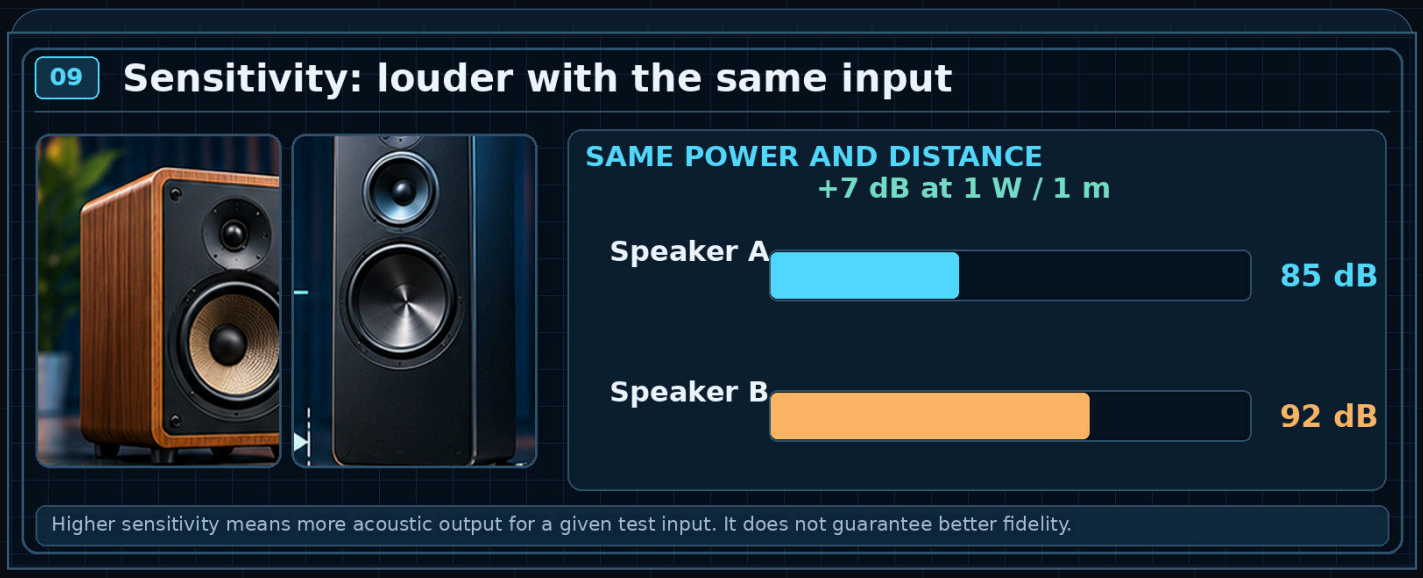
**EXPLORE THE LESSON ONLINE**

Bass extension

09 / LOUDSPEAKERS

# Sensitivity: louder with the same input?

Speaker sensitivity connects electrical input to measured sound output at a specified distance.




## UNDERSTAND A TYPICAL RATING

A label such as 87 dB at 2.83 V, measured at 1 m, claims a certain sound-pressure level for that voltage at that distance. One metre is about 3.28 feet. This is not the same as maximum clean loudness.

## THE SMALL-PRINT TRAP

Across an ideal 8-ohm resistor, 2.83 V is about one watt. Across an ideal 4-ohm resistor it is about two watts. A voltage-based sensitivity comparison can therefore disguise a difference in test power.

### FROM THE CURATOR'S NOTES

*The old D5 specification listed* **96 dB SPL at 1 watt, 1 metre**. *In plain English, they could make plenty of sound without needing a huge amount of power. I knew they had some serious punch, but it was later, in a different house where I could really turn up the Denon without disturbing hotel guests, that I found out just how much. Those Cerwins could rattle the windows. They brought drum hits and guitar riffs right into the room in a way I loved, even if they weren't nearly as spacious as the Paradigms I enjoy today.*

## WHAT IT HELPS YOU DECIDE

Sensitivity is useful when estimating whether an amplifier has enough output for your listening distance and loudest moments. It says very little by itself about bass reach, smoothness, dispersion or preferred tone.

### KEEP THIS IN MIND

Higher sensitivity can make loud playback easier, but it is not the same thing as better fidelity.

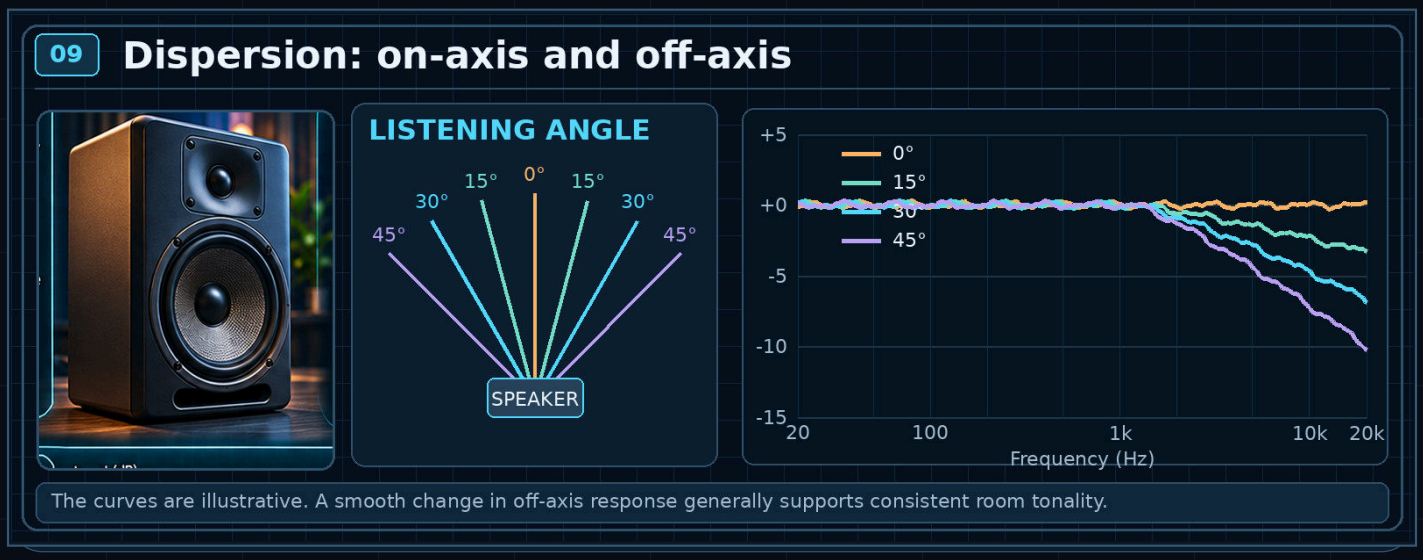
## EXPLORE THE LESSON ONLINE

Speaker sensitivity

09 / LOUDSPEAKERS

# Dispersion: what happens off to the side?

A speaker radiates different amounts of sound in different directions, and this pattern changes with frequency.




## MOVE ACROSS THE COUCH

A speaker may sound balanced directly in front but lose treble or change its upper-mid balance off to one side. The direct sound changes, and the walls receive a different balance of reflected frequencies as well.

## READ AN OFF-AXIS EXAMPLE

If a speaker measures 6 dB lower at 8 kHz, 30 degrees off axis than directly ahead, that is a comparison at one frequency, input and distance. It does not mean the whole song becomes 6 dB quieter.

## WHY CONSISTENCY MATTERS

A speaker with smoothly changing off-axis response can produce a more consistent tonal balance around the room than one with abrupt directional changes. The actual room, orientation, seating and vertical listening angle remain important.

### FROM THE CURATOR'S NOTES

*One of the things that draws me to the Phantom v1s is the way a good stereo recording seems to open up around them. Moving a little sideways doesn't immediately make the high notes sound like they've disappeared. Their broad, fairly consistent sound to the sides, helped by a tweeter designed to spread the highs, seems to be part of why I like them so much. The old D5s were fantastic at getting the music up and moving; these are the ones I enjoy for that sense of width and placement.*

### KEEP THIS IN MIND

Frequency response describes tone in one direction. Dispersion describes how that response changes as you move.

## EXPLORE THE LESSON ONLINE

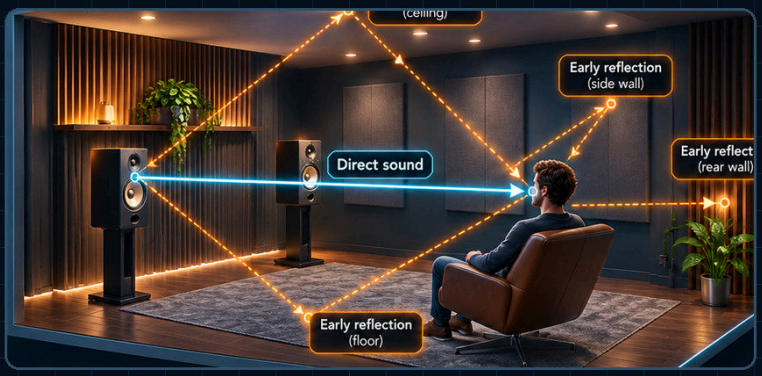
Speaker dispersion

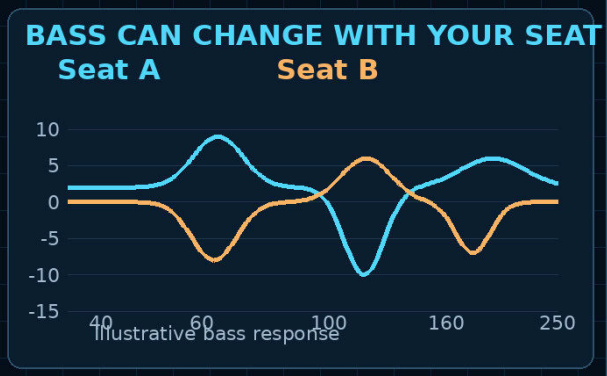
10 / THE ROOM

# Your listening room is part of the system

Even a carefully designed speaker changes character when you move it, change the room or sit somewhere else.

10 Your listening room is part of the system




Two listening positions can hear different bass from the same speakers. Test placement before buying gear.

## DIRECT SOUND AND REFLECTED SOUND

You hear the speaker directly, and you also hear delayed versions bouncing from walls, floor and ceiling. Those reflections can influence tone, clarity and the sense of where an instrument appears.

## BASS BUILDS UP AND CANCELS

At low frequencies, sound interacts strongly with room boundaries. Some seats may have booming bass while others have weak notes. Moving a chair or loudspeaker a modest distance can change the balance more than swapping a capable amplifier.

### FROM THE CURATOR'S NOTES

*One thing I noticed with the A-720 and Phantom v1s was that some fairly compressed recordings could get muddy when I turned them up, especially with the speakers pointed straight at my listening position. I'd read an old review of the Phantoms that suggested aiming them straight ahead instead, so I gave it a try. It made a considerable difference. With my listening seat now off-axis, the sound cleaned up and the instruments were easier to follow, even on those busier recordings at higher volumes. What I didn't expect was the bonus: at lower volumes, especially with better-recorded music, the whole presentation seemed to open up. More space around the instruments, clearer placement and a wider sense of the recording. Same equipment, just a different speaker angle. It didn't cost me a cent.*

## START WITH FREE ADJUSTMENTS

Try a sensible stereo triangle, stable speaker supports, similar left/right surroundings, and consistent distance to the listening position. Toe-in may change how much on-axis treble reaches you. Make one adjustment at a time and keep notes.

### KEEP THIS IN MIND

Before buying a different speaker, test position, seat and orientation. Free changes can be remarkably audible.

EXPLORE THE LESSON ONLINE

Speaker dispersion

11 / HEADPHONES

# Three designs, different trade-offs




## WHAT TO LISTEN FOR

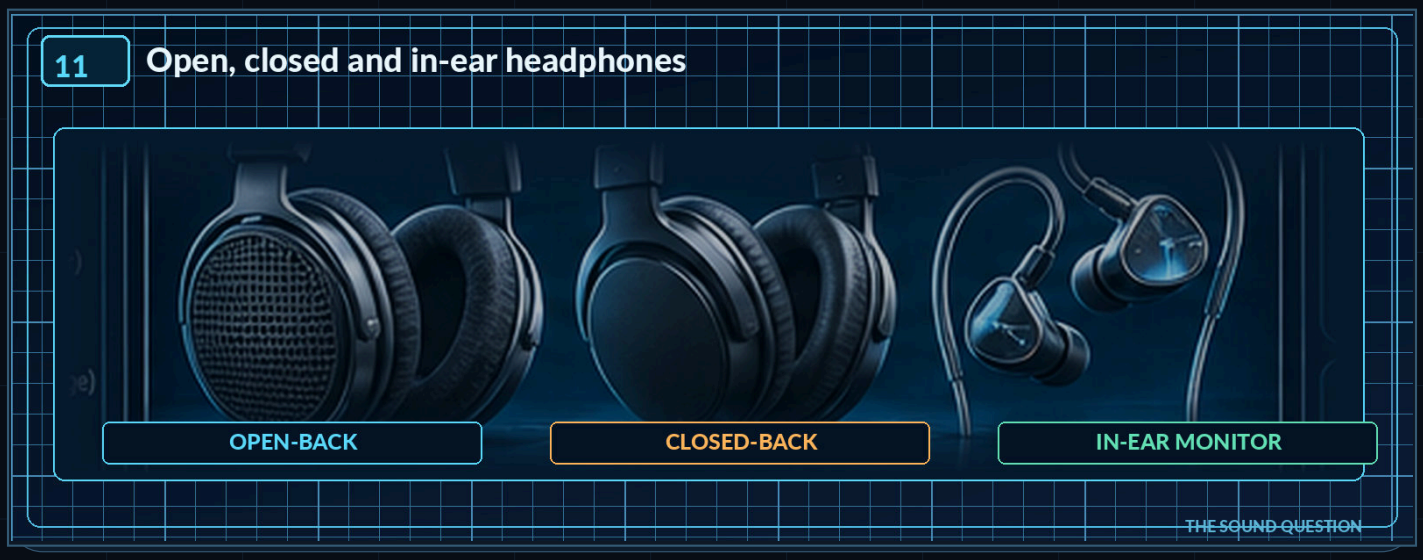
Open-back, closed-back and in-ear designs use quite different physical arrangements. Their fit, acoustic leakage, frequency response and isolation all affect the listening experience.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

11 / HEADPHONES

# Open-back, closed-back and fit

Headphones put their drivers right beside your ears. Their enclosure and the seal around your ears can strongly change what reaches you.




### OPEN-BACK VERSUS CLOSED-BACK

An open-back headphone allows more sound to pass between the driver and room. Many people like its presentation in a quiet room, but it leaks sound and offers little isolation. A closed-back design generally reduces leakage and may provide more isolation, though individual designs vary.

### FIT CAN CHANGE BASS

A loose ear pad, glasses, hair or an IEM tip that does not seal well can reduce low-frequency output. A headphone that seems thin might not have its intended fit. Before comparing models, check the seal and repeatable placement.

### DRIVER NAMES DO NOT PICK A WINNER

Dynamic, planar-magnetic and other driver systems have different engineering approaches. Their actual tuning, distortion, comfort, efficiency and fit matter more than a technology label. Listening preference remains personal.

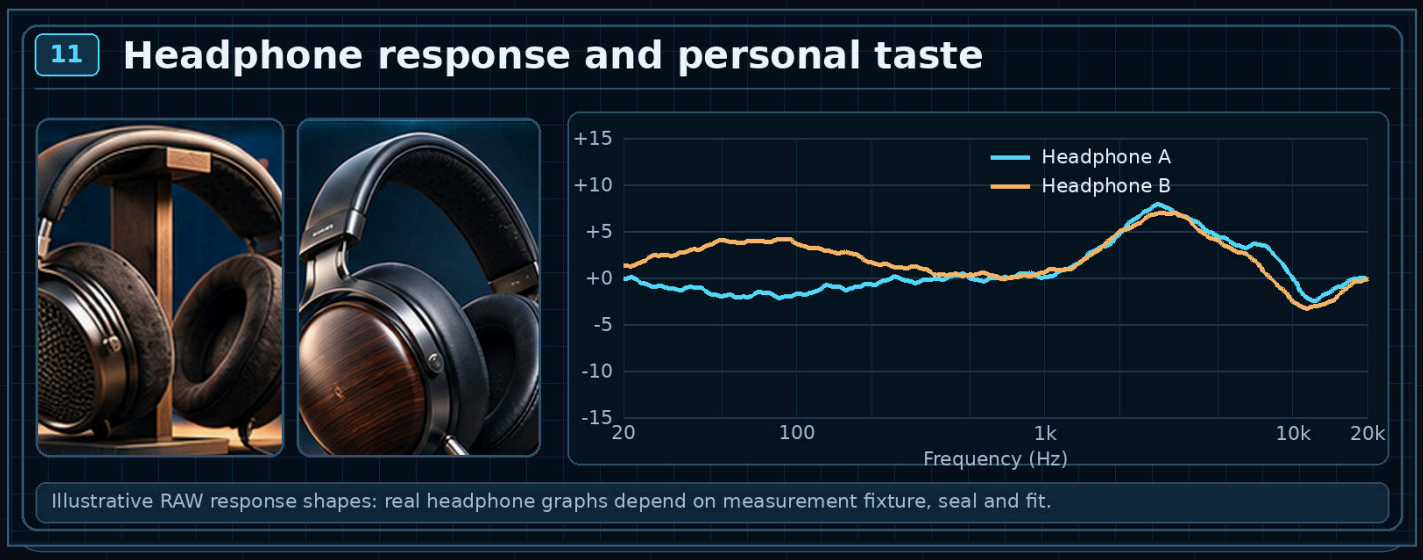
> **KEEP THIS IN MIND**
> For headphones, a change in fit can masquerade as a change in sound quality.

**EXPLORE THE LESSON ONLINE**
Headphone types and fit

11 / HEADPHONES

# Headphone response and personal taste

Two headphones can reproduce the same song with noticeably different balances, and neither has to be everyone's favourite.




## LOOK AT THE WHOLE RESPONSE

A range claim of 20 Hz-20 kHz does not show which notes are emphasized or reduced. Headphone response measurements also depend strongly on the test fixture and how the headphone sits on it; a perfectly flat-looking graph is not necessarily the desired response at an ear.

## YOUR PREFERENCE IS ALLOWED

One listener may enjoy full bass, another may prefer prominent guitars and clear percussion. A preference does not automatically show which is objectively closer to a reference target. Different brands, and even different models in one brand, can make very different choices.

### FROM THE CURATOR'S NOTES

*I tend to enjoy the Grado headphone presentation more than the bass-forward Beats sound I've tried. That doesn't make the Grados the right recommendation for someone who wants plenty of bass. They might prefer a different headphone entirely, and that's a perfectly reasonable choice.*

## BEFORE SPENDING

Match playback levels, check pad condition and fit, try equalization when appropriate, and use a range of familiar recordings. A costly headphone may genuinely do something better, but the improvement must be relevant to your own listening.

### KEEP THIS IN MIND

A measurement can help explain a preference without declaring that everyone must share it.

## EXPLORE THE LESSON ONLINE

Headphone frequency response

11 / HEADPHONES

# Will this headphone work with my source?

Headphones need an output that can supply enough voltage and current without unwanted hiss or distortion.




## IMPEDANCE ALONE IS NOT ENOUGH

A 300-ohm headphone does not automatically need a giant amplifier, and a 32-ohm one is not automatically easy to drive. Sensitivity tells you how loud the headphone gets from a stated input. Pay attention to whether the number is dB per volt or dB per milliwatt.

## DIFFERENT KINDS OF OUTPUT LIMITS

Some headphone outputs run out of voltage with higher-impedance headphones. Others may struggle to supply current into low-impedance loads. Highly sensitive in-ear monitors may reveal background hiss that ordinary headphones do not.

## OUTPUT IMPEDANCE CAN CHANGE TONE

If the source has appreciable output impedance and the headphone's own impedance changes with frequency, the delivered voltage may change across the spectrum. That can alter the tonal balance. A suitably low output impedance is a useful default unless there is a specific design reason otherwise.

**KEEP THIS IN MIND**

Check sensitivity, impedance, available output and noise together, not one number in isolation.

**EXPLORE THE LESSON ONLINE**

Headphone sensitivity

12 / LISTENING LANGUAGE

# More than bright, warm and punchy




## WHAT TO LISTEN FOR

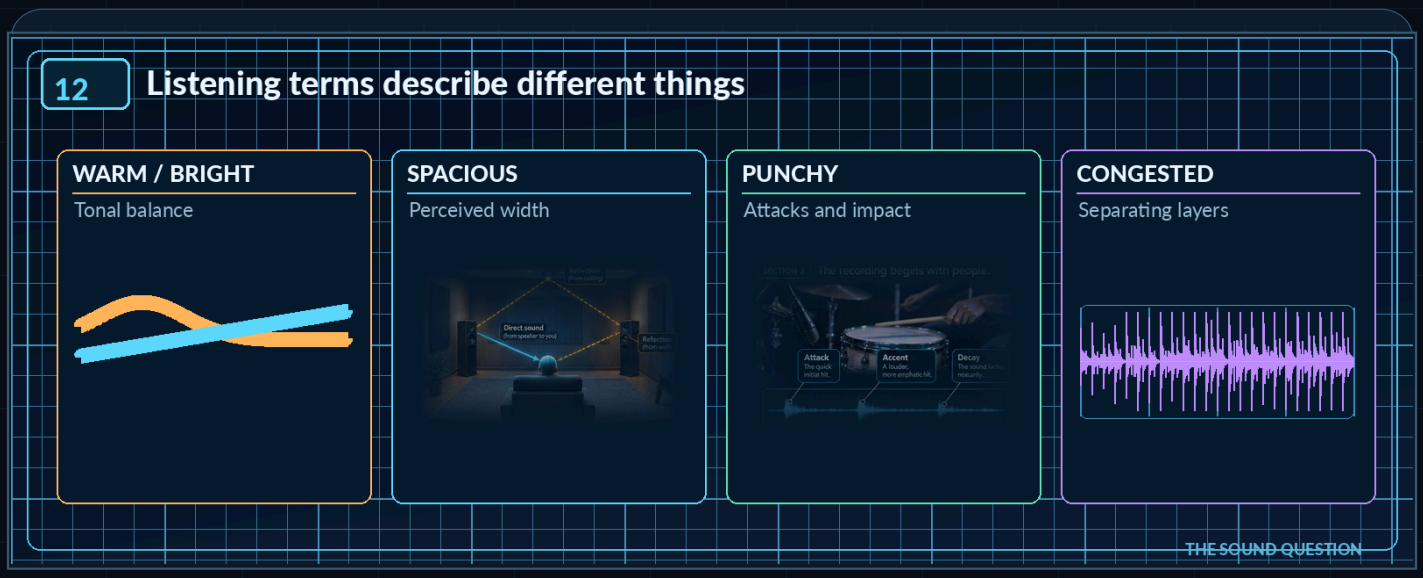
Spatial placement, separation, tonal balance, transients and perceived depth describe different listening impressions. No one graph can explain all of them.

FOLLOW THE NEXT PAGES FOR THE EXPLANATION

12 / LISTENING LANGUAGE

# Warm, bright, punchy and holographic

Audiophile terms can be useful descriptions, but none is a standardized test result by itself.




## START WITH A PLAIN-LANGUAGE MEANING

Warm often means more lower-mid or bass body, or less prominent treble. Bright often means more upper-frequency energy. Punchy usually describes a strong sense of attack and impact. Neither word proves a particular frequency-response curve.

## SPATIAL WORDS DESCRIBE AN IMPRESSION

Soundstage describes the apparent extent of the musical scene. Imaging describes how distinctly we locate its parts. Holographic is usually praise for a particularly convincing three-dimensional impression. Recording techniques, speaker placement, room and listener all contribute.

## CONGESTED IS AN OBSERVATION

If instruments become hard to follow, you can reasonably describe the result as congested. But deciding whether the recording, speaker, amplifier or room is responsible requires a comparison. The word cannot tell you the cause.

### FROM THE CURATOR'S NOTES

*I'd describe the old Cerwin-Vegas as punchy and in your face. A snare hit or guitar riff seemed to jump right out at me. With the Yamaha and Paradigms, words like balanced, open and spacious come to mind instead. Neither description is a trophy. They're two ways I enjoy hearing music, and the words help explain what I'm paying attention to.*

### KEEP THIS IN MIND

Describe what changed first; propose a cause second. That habit keeps subjective language useful.

EXPLORE THE LESSON ONLINE

Audiophile Decoder glossary

12 / LISTENING LANGUAGE

# What the words might be pointing toward

Different pieces of a system can create similar impressions. Avoid giving a single listening adjective a single automatic explanation.




### TOO BRIGHT OR TOO DARK?

A broad change in tonal balance may be caused by the recording, mastering, speaker or headphone response, equalization, placement or room. Compare a known recording and check whether the characteristic follows the equipment or just one album.

### MORE SEPARATION, LESS CONGESTION?

Possible contributors include the mix, masking between instruments, changes in frequency balance, room reflections, speaker limits and added distortion at louder levels. Imaging and separation are not the same as a measurement of crosstalk.

### MORE BASS BUT LESS DEFINITION?

Room peaks can make certain bass notes overpower everything else. A speaker pushed close to its limit can also change behaviour. Another recording may simply contain much more energy in the same region. Check level, placement and several songs before deciding.

**KEEP THIS IN MIND**

The same audible symptom can have several causes. A useful explanation makes predictions that can be checked.

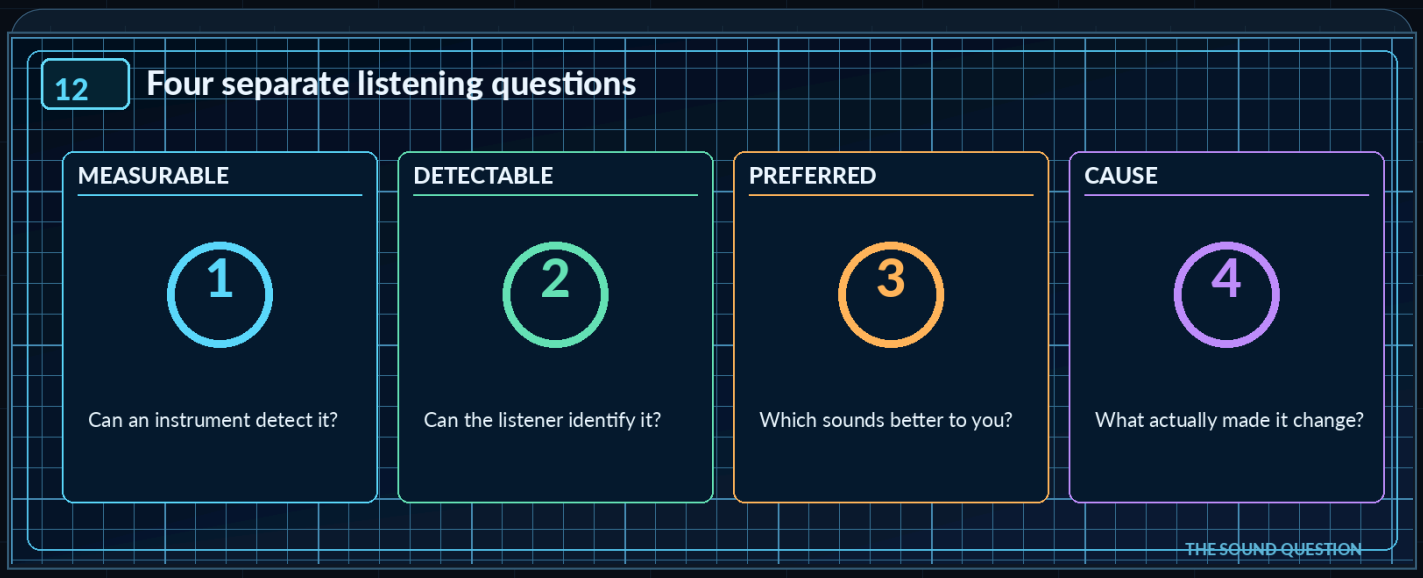
**EXPLORE THE LESSON ONLINE**

Audiophile Decoder glossary

12 / LISTENING LANGUAGE

# Listening impressions are not measurements

People can accurately report an experience while being mistaken about what caused it.




## SEPARATE FOUR QUESTIONS

Is a difference measurable? Can the listener detect it under controlled conditions? Which version does the listener prefer? And what actually caused the difference? These are related questions, but their answers are not interchangeable.

## A PERSONAL REPORT IS STILL USEFUL

If a stereo becomes harsh at a higher volume, that is a useful starting observation. It does not prove the power supply, DAC or speaker driver is responsible. An electrical measurement or a controlled change may eliminate some explanations.

## DO NOT DISMISS ENJOYMENT

A listener may prefer an intentionally coloured speaker or a particular master even if another is technically more accurate. Accuracy and enjoyment can overlap, but one does not automatically decide the other.

**KEEP THIS IN MIND**

Be clear about what you heard, what you measured and what you merely suspect.

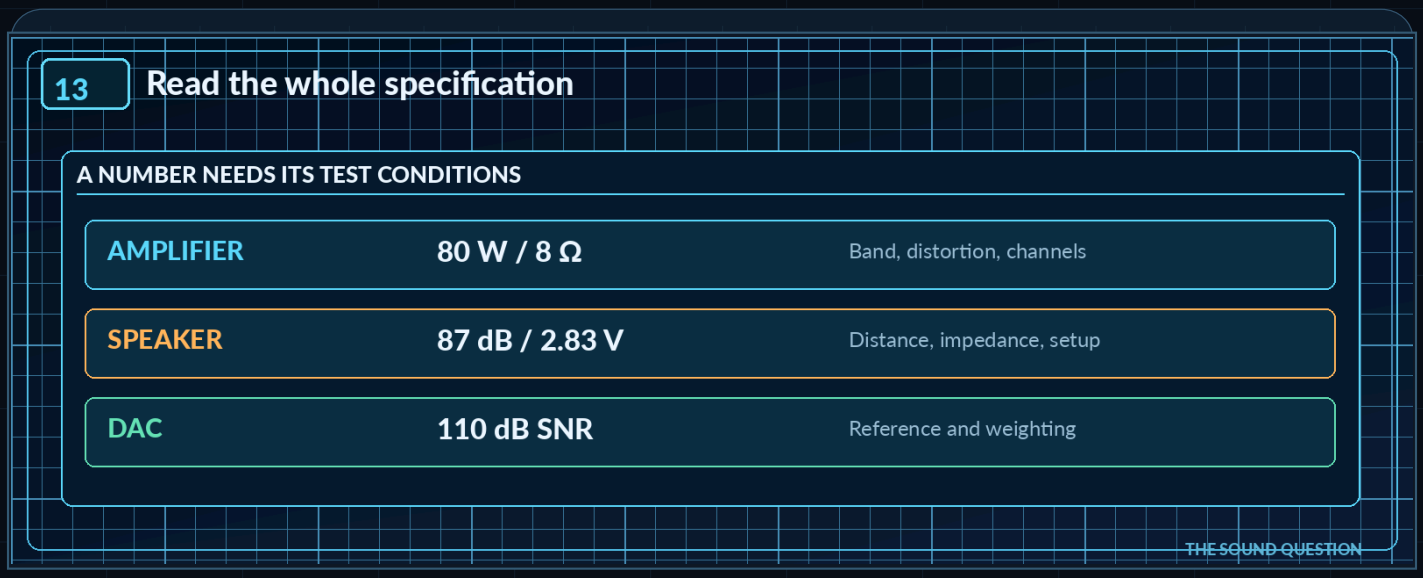
**EXPLORE THE LESSON ONLINE**

Audiophile Decoder glossary

13 / READING SPECIFICATIONS

# A small number can hide a big question

Specification sheets are most useful when they tell you the conditions under which a result was obtained.




### AMPLIFIER: 80 W / 8 OHMS / 20 HZ-20 KHZ

This is more useful than just 80 W because it gives a load and frequency span. It still needs a distortion threshold and test setup. Was the rating continuous? Were both channels driven? A power claim without those conditions may not be directly comparable.

### SPEAKER: 87 DB / 2.83 V / 1 M

This tells you a test input and distance. It does not tell you maximum clean output, the listening-room response or how the speaker behaves with more power. Four-ohm and eight-ohm ratings need careful comparison.

### DAC: 110 DB SNR OR 192 KHZ SUPPORT

One refers to measured signal-to-noise under specified conditions; the other to a supported sampling rate. They do not describe the same quality, and neither, alone, predicts how a complete stereo will sound.

**KEEP THIS IN MIND**

Always ask: at what level, into what load, over which frequencies, by what method?

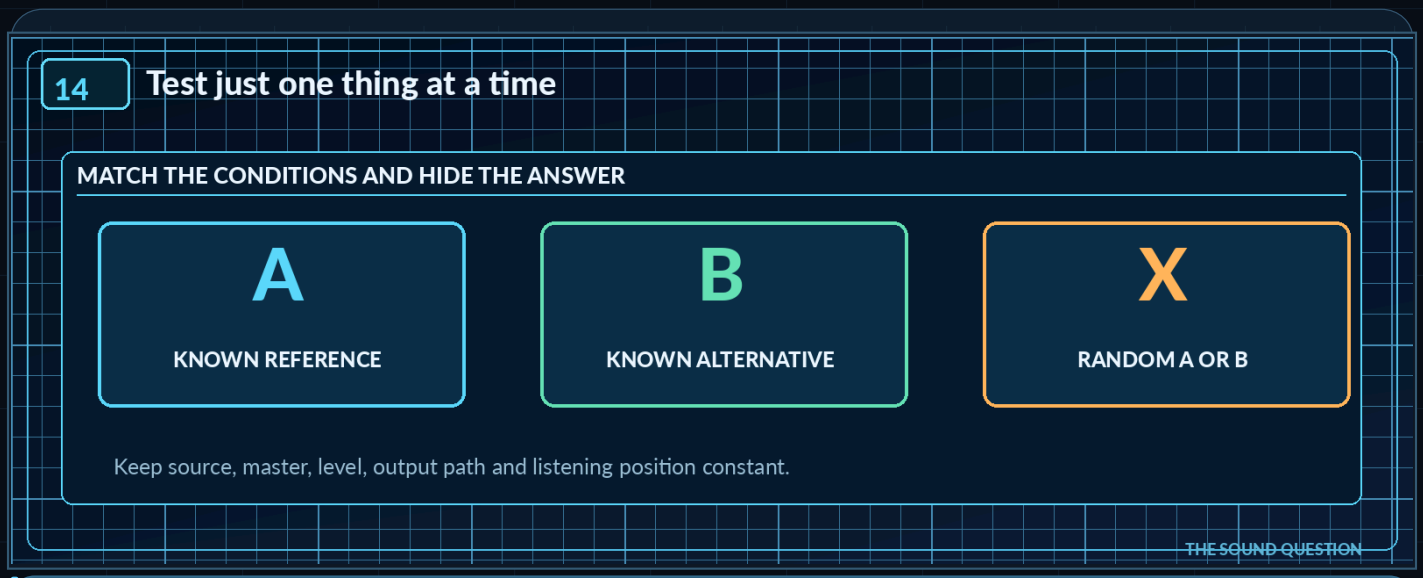
**EXPLORE THE LESSON ONLINE**

Spec Decoder quick reference

14 / TESTING CLAIMS

# How to test a difference without fooling yourself

Good listening comparisons should make it harder for unrelated changes to masquerade as improvements.




**FROM THE CURATOR'S NOTES**

*My childhood Denon/Cerwin-Vega and Yamaha/Pioneer comparison tells me I heard two very different presentations. But we changed the amplifier, speakers and likely the room and playback level. Looking back, I can't honestly use that memory to prove which box caused the difference.*

## CHANGE ONE THING

Use the same music, same master, speakers, positions and listening distance while changing only the equipment or setting under investigation. If you swap speakers and amplifiers at the same time, you cannot tell which caused the difference.

## MATCH THE LEVEL

Even a small loudness difference can influence preference or attention. When practical, use a calibrated test or carefully measured levels. Guessing by the volume knobs is not reliable because the same knob position does not guarantee the same output.

## BLIND WHEN THE QUESTION NEEDS IT

Hiding brand or format identity can reduce expectation effects. An ABX comparison can test whether a difference is detectable in a defined setup. It does not automatically establish which option should be purchased, or whether a listener enjoys one more.

## RECORD A MODEST CONCLUSION

A result from one listener, one room or one set of tracks cannot establish a universal rule. Keep notes about the equipment, level, source and anything you could not control.

**KEEP THIS IN MIND**

Repeatable, modest claims are more valuable than confident stories that change five variables at once.

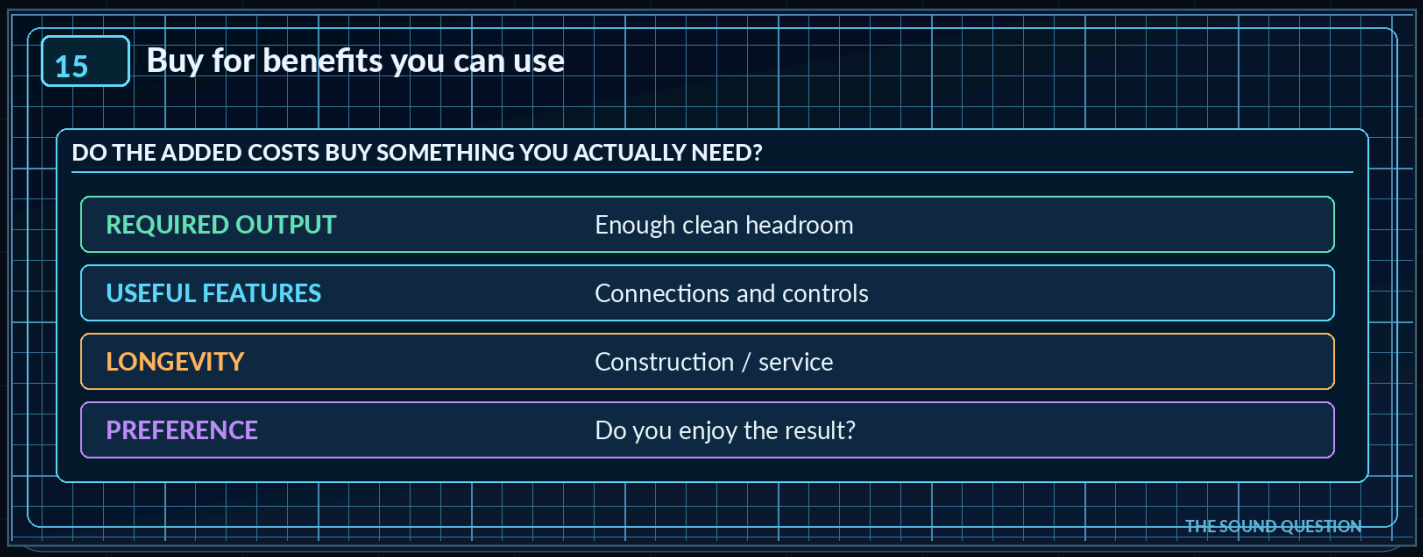
EXPLORE THE LESSON ONLINE
Lossy and lossless audio

TRY THE LISTENING LAB
ABX sound tests

15 / BUYING AUDIO GEAR

# Expensive, inexpensive or simply appropriate?

Price can reflect real engineering, attractive materials, convenience or marketing. The useful question is what matters to this listener.




## FIRST IDENTIFY YOUR GOAL

Do you want enough clean volume for a large room, a headphone with more bass, quieter background noise, HDMI convenience, or a more natural-sounding speaker? These are different needs. A device that wins one test may be poor value for another.

**FROM THE CURATOR'S NOTES**

*I'm not looking for the cheapest thing at any cost, or the most expensive thing for the sake of it. I want to know what the extra money actually buys, whether I can hear or use the improvement, and whether it's worth it for the music and system I have.*

## WHAT CAN EXTRA MONEY BUY?

More output headroom, harder-to-build drivers, lower measured noise, better mechanical construction, reliable service, connectivity and genuine manufacturing care can all cost money. A premium component may provide real benefits that are irrelevant in a particular setup.

## USE THE SAME STANDARD FOR EVERY PRICE

Do not assume cheap gear always wins or expensive gear always sounds better. Research the actual performance, audibility, usability and total cost. Used equipment also brings condition and repair considerations. Personal preference belongs beside the measurements, not underneath them.

**KEEP THIS IN MIND**

The best value is the best defensible compromise for your needs, not automatically the lowest sticker price.

**EXPLORE THE LESSON ONLINE**

Spec Decoder quick reference

16 / BUILDING A SYSTEM

# Match the system, not just the boxes

A good system begins with the music, room, listening distance and desired sound level.




### START WITH THE ROOM AND SPEAKERS

Speakers and their placement strongly affect the final result. Consider size, bass needs, listening distance and whether you can position them properly. Try free adjustments before buying replacements.

### THEN CHECK THE AMPLIFIER

Confirm the impedance compatibility, clean power and headroom needed for the speakers and listening level. An amplifier with convenient inputs, reliable operation and sufficient margin can be the sensible choice even if a more expensive model measures better on some irrelevant axis.

### FINALLY CHECK SOURCE AND CONNECTIONS

Confirm whether each device provides digital, line-level or phono signals, and that gain and output levels are suitable. A well-connected simple system is better than a collection of impressive specifications that do not work together.

**KEEP THIS IN MIND**

System Check and System Builder help estimate compatibility and explore trade-offs. Neither substitutes for a real measurement of the equipment in your room.

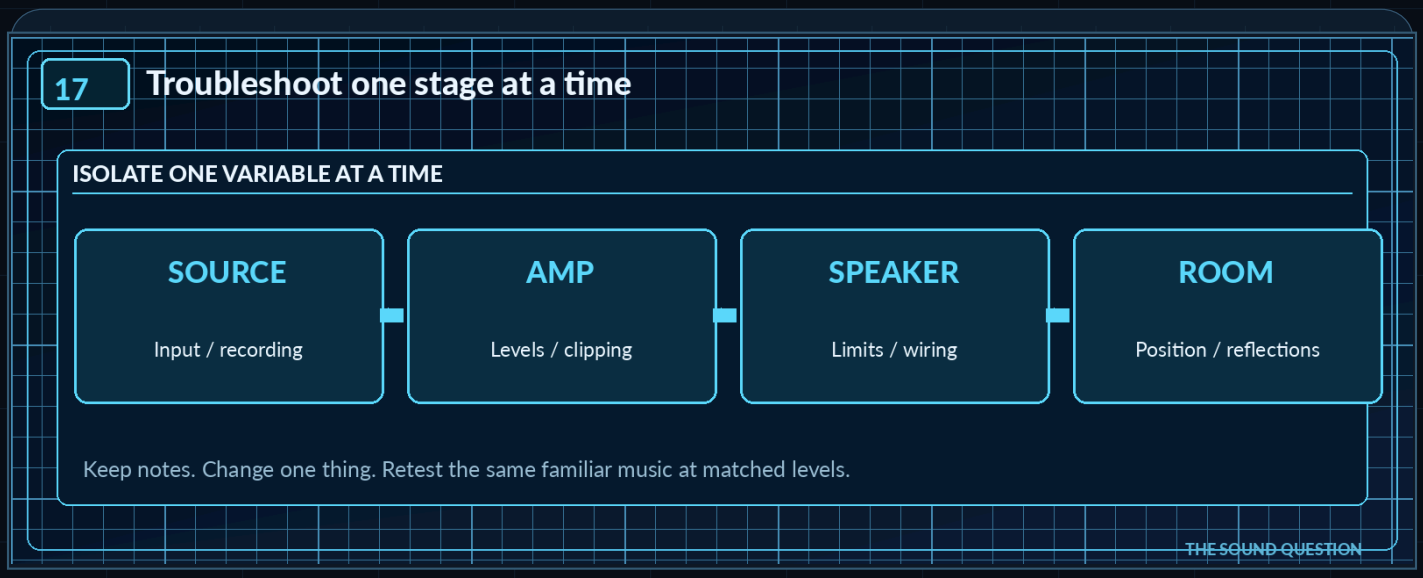
**EXPLORE THE LESSON ONLINE**

System Check calculator

17 / TROUBLESHOOTING

# When the sound goes wrong

Before replacing a component, narrow the problem to the stage where it begins.




### HARSH OR DISTORTED

Does the problem happen on one recording or all of them? Does it begin only at higher volume? Try a known clean source, moderate level and the simplest signal route. Investigate clipping, processing, source overload, speaker strain and amplifier limits before blaming one part.

### MUDDY OR CONGESTED

Compare sparse and dense music, change listening level and note whether the room is contributing excessive bass. Inspect speaker placement. If separation collapses only as volume rises, test whether the system is approaching a limit rather than assuming the master is responsible.

### WEAK BASS OR STRANGE STEREO

Check polarity, left/right channels, speaker placement and subwoofer integration. With headphones, check seal. Reflections and room nulls can remove bass at one seat even when the speaker is capable. Make adjustments one at a time.

**KEEP THIS IN MIND**

A systematic comparison usually teaches more than an immediate equipment purchase.

**EXPLORE THE LESSON ONLINE**

Audiophile Decoder glossary

REFERENCE / ALPHABETICAL GLOSSARY

# Quick glossary

**ABX:** A listening test where X is secretly either known sample A or known sample B.

**Amplifier headroom:** Remaining clean output available for louder musical moments.

**Class A / Class AB:** Two ways an amplifier output stage shares the work of reproducing a signal; neither guarantees a particular sound.

**Crossover distortion:** An amplifier error that can occur when one output device hands the signal over to another; different from a speaker crossover.

**Analogue:** A continuously varying electrical or physical signal.

**Bit depth:** The available numerical steps used to represent a digital sample level.

**Bright:** A perceived emphasis in upper-frequency sound; an impression, not a diagnosis.

**Clipping:** Signal peaks exceeding a stage's available range and changing shape.

**Compression:** Processing that changes how much louder strong moments are than quieter ones.

**Crossover:** A filter network that directs frequency ranges to suitable speaker drivers.

**DAC:** Digital-to-analogue converter; turns digital samples into an analogue output.

**dB:** Decibel; a logarithmic way to describe level differences or ratios.

**Dispersion:** How a speaker distributes sound in different directions.

**Distortion:** An unwanted or intentional change that adds or alters signal content.

**Dynamic range:** A level span; the exact meaning depends on what is being measured.

**EQ:** Equalization; adjusting the balance of selected frequency ranges.

**Frequency response:** How output varies with frequency in a defined test setup.

**Gain:** How much a stage increases or reduces signal level.

**Headphone sensitivity:** How much sound output results from a stated electrical input.

**Input sensitivity:** How much signal an amplifier input needs to reach a stated output level; not its maximum safe input level.

**Imaging:** How clearly and consistently sounds appear to occupy positions.

**Impedance:** How a device opposes alternating current; can vary with frequency.

**Line level:** An ordinary analogue connection level for sources and amplifiers.

**Monitor (tape deck):** A way to listen to the incoming recording signal or the recorded tape, depending on deck and switch position.

## QUICK GLOSSARY / CONTINUED

**Lossless:** Encoding that lets a decoder restore the original encoded data.

**Lossy:** Encoding that deliberately discards or approximates some information.

**Masking:** One sound making another harder to hear.

**Mastering:** Preparing and finalizing a mix for distribution, potentially altering its tone or loudness.

**Mixing:** Combining tracks and choosing their level, tone, position and effects.

**Ohm:** Unit used to express electrical resistance and impedance magnitude.

**PCM:** Pulse-code modulation; common digital audio representation as sample numbers.

**Peak:** A highest short-term level of a signal or sound, defined by the measurement.

**Phono stage:** Circuit that amplifies and equalizes the small signal from a record cartridge.

**RMS:** Root mean square; an effective value for a varying voltage or current.

**Sample rate:** Number of digital readings per second for each audio channel.

**Sensitivity:** Measured sound output for a specified electrical input and setup.

**SNR:** Signal-to-noise ratio; reference signal level compared with background noise.

**Soundstage:** The perceived width, depth and extent of a musical scene.

**SPL:** Sound pressure level; measured acoustic level in decibels relative to a reference.

**THD / THD+N:** Harmonic distortion estimate, with +N also including noise.

**Transient:** A brief change in sound, such as the initial strike of a drum.

**Voltage:** The electrical potential difference applied across a load.

**Warm:** Perceived fullness or softened upper balance; not one universal frequency curve.

**Watt:** Unit of power; a load, test signal and conditions are needed for comparison.

SOURCES / EXPLORE FURTHER

# References and further reading

- The Sound Journey
- Spec Sheet Decoder lesson library
- The Audiophile Decoder glossary
- System Check: amplifier and speaker estimates
- Audio sources, formats and signal paths
- Mixing and mastering lessons
- Speaker directivity introduction (Spinorama)
- KLIPPEL near-field scanning background
- ITU-R BS.1116: controlled listening assessment
- AES audio loudness project
- Cerwin-Vega D5 period specification listing (Stereo Review, 1986) (manufacturer-stated figures in a contemporary catalogue, not independent measurements)
- Yamaha A-720 original service specifications (manufacturer figures; do not redistribute manual pages)
- Denon PMA-500V original operating manual

- Analog Devices: why Class AB uses bias to reduce crossover distortion
- The Listening Lab: ABX sound tests

THE SOUND QUESTION

# HEAR IT.
# QUESTION IT.
# MAKE IT MAKE SENSE.



thesoundquestion.com