FOURTH EDITION

mixing audio

CONCEPTS | PRACTICES | TOOLS

ROEY IZHAKI
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A **Focal Press** Book

ROUTLEDGE

Mixing Audio

Mixing Audio: Concepts, Practices, and Tools is a vital read for anyone wanting to succeed in the field of mixing—covering the entire mixing process, from fundamental concepts to advanced techniques.

Packed full of photos, graphs, diagrams, and audio samples, it teaches the importance of a mixing vision, how to craft and evaluate your mix, and then take it a step further. *Mixing Audio* describes the theory, the tools, and how these are put into practice while creating mixes. The companion website, featuring over 2,000 audio samples as well as Multitrack Audio Sessions, is a perfect complement to the book.

The new edition includes:

- An extension of the discussion on mastering which now includes the loudness war, LUFS targets, and DIY mastering
- Updated figures and illustrations throughout
- A new section covering console emulation

Roey Izhaki holds a BA in recording arts and has been mixing since 1992. As an audio engineering academic lecturer for 10 years, he has given mixing and audio seminars across Europe.

"Roey Izhaki has put together a text complete with the history, background, tools and techniques needed to develop a solid foundation in the art of mixing audio. His easy-to-read explanations of the various techniques he employs along with the included audio examples will serve someone new to mixing or that seasoned professional looking for a refresher."

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Mixing Audio

Concepts, Practices, and Tools

Fourth Edition

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Contents

Symbols used

Audio samples
www.MixingAudio.com/audio
Tracks referenced within these boxes are included on the website, organized in folders by chapter. Please mind your monitoring level when playing these tracks.

Notes
These boxes contain tips or other ideas worth remembering.

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Introduction

It's not often a new form of art is conceived; where or when the art of mixing was born is not easy to answer. We can look at the instrumentation of orchestral pieces as a very primitive form of mixing—different instruments that played simultaneously could mask one another; composers understood this and took it into account. In the early days of recording, before multitrack recorders came about, a producer would place musicians in a room so that the final recording would make sense in terms of levels and depth. Equalizers, compressors, and reverbs hadn't yet been invented; there was no such role as a mixing engineer either, but sonically combining various instruments in order to produce an appealing, coherent, and aesthetic sound was an ambition shared by many.

Like many other new forms of creative expression that emerged in the twentieth century, mixing was tied to technology. It was the appearance of the multitrack tape machine during the 1960s that signified the dawn of mixing as we know it today. Yes, there was a time when having the ability to record eight instruments separately was a dream come true. Multitracks allowed us to repeatedly play recorded material before committing sonic treatment to the mix. Equalizers, compressors, and reverbs soon became customary in studios; audio consoles grew in size to accommodate more tracks and facilities. We had more sonic control over individual tracks and over the final master. The art of mixing was flourishing. Music sounded better.

The 1990s significantly reshaped much of the way music is made, produced, recorded, mixed, and even distributed—computers triumphed. Realtime audio plugins were first introduced with the release of Pro Tools III as far back as 1994, but such a setup required a dedicated DSP card. It was Steinberg's 1996 release of Cubase VST that gave us the audio plugins we now take for granted—a piece of software that can perform realtime audio calculations using the computer's CPU. The term *project studio* was soon coined as computers became more affordable and capable, and the hiring of expensive studios was no longer a requisite for multitracking and mixing. However, the processing power of computers back then could still not compete with the quality and quantity of mixing devices found in a professional studio.

Things have changed—running ten quality reverbs simultaneously on a modern DAW has been a reality for some time. There are now more audio plugins in the market than hardware units, and the quality of these plugins is constantly improving. Professional studios will always, it seems, have an advantage over project studios, if only for their acoustic qualities. However, DAWs offer outstanding value for money, constantly improving quality and widening possibilities.

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So is everything rosy in the realm of mixing? Not quite. It is thanks to computers that mixing has moved from large and expensive studios into bedrooms. More people than ever are mixing music, but only a few can be labeled experts. Mixing used to be done by skilled engineers, who were familiar with their studio and the relatively small set of expensive devices it contained. Mixing was their occupation—and for many their *raison d'être*. On the contrary, project studio owners generally do much more than just mixing—for many, it is just another stage in an independent production chain. So how can these people improve their mixing, specifically when time is often constrained?

This is where this book comes in. When the first word of this book was typed back in 2004, mixing literature was limited, cluttered, and often only scratched the surface. This book was originally conceived to stand as a much-needed comprehensive source. It is hard to believe that nowadays, we have the opposite problem—there is too much out there, and, if literature isn't enough, there are also blog posts, online forums, and video tutorials. As we humans are increasingly and involuntarily assuming the role of information filters in this vast jungle called the web, a book such as this can spare many the foraging—what you need or wish to know in one place.

Being comprehensive doesn't come without a cost, though. This book is long; painfully long if you ask me. Perhaps of little comfort is that this book isn't quite a cover-to-cover type of read—feel free to stop reading now, look at the table of contents, and jump to the topic of most interest to you. Possibly not everything will be clear without reading some preceding chapters, but you should grasp the bulk of it. Regardless, many readers have testified that with so much to digest, it was only on the second or third reading understanding sunk in.

I would like, in this opening text, to expose the greatest misconception that exists about mixing: it is wrongly assumed by some that mixing is a purely technical service, and some even declare that mixing is simply a remedy for imperfect recordings. There is no doubt that mixing entails technical aspects: a problematic level balance, uncontrolled dynamics, and deficient frequency response are just a few of the technical issues we encounter. Yet, with the right amount of effort, almost anybody can master the technical aspects of mixing—after compressing 100 vocal tracks, one should be getting the hang of it. Technical skills are advantageous but can be equally acquired by all. The true essence of mixing does not lie in these skills. Many mixes are technically great, but nothing more than that; equally, many mixes exhibit some technical flaws, but as a listening experience they are breathtaking. It is for their sheer creativity—not for their technical brilliance—that some mixes are highly acclaimed and their creators deemed sonic visionaries.

The sonic qualities of music are inseparable from the music itself—the Motown sound, the Neve sound, the Wallace sound, and so forth. The nontechnical side of mixing entails crafting the sonic aspects of music: shaping sounds, crystallizing soundscapes, establishing harmony between instruments, and building impact—all rely on the many creative decisions that we make; all are down to the talent and vision of each individual; all have a profound influence on how the music is perceived. It is in the equalization we dial, in the reverb we choose, in the attack we set on the compressor, to name but a few. There simply isn't one correct way of doing things—be it an acoustic guitar, a kick, or any other instrument, it can be mixed in 100 ways; all could be considered technically correct, but some would be more remarkable than others. A mix is a sonic portrait of

the music. The same way different portraits of a person can each project a unique impression, different mixes can convey the essence of the music in extremely different ways. We are mixing engineers, but more importantly: we are *sonic artists*.

By the time you finish reading this book, you should have far more knowledge, a greater understanding, and improved auditory skills that will together enable you to craft better mixes. However, I hope that you keep this in mind:

Mixing is an art.

A friendly warning—mind your listening levels

It would not make sense for wine tasters to sip boiling oil, just as it would not make sense for mixing engineers to stick sharp needles into their eardrums. While I have yet to meet an engineer who fancies needles in his or her eardrums, very loud levels can be equally harmful. Unlike needle-sticking, the hearing damage caused by loud levels is often not immediate, whether involving short or long periods of exposure.

Sparing the medical terminology, with years one might lose the ability to hear high frequencies, and the really unlucky could lose substantial hearing ability. In some circumstances, very loud levels can cause permanent damage to the eardrum and even deafness. Most audio engineers have had one or two level-accidents; the majority of us are fine. But hearing a continuous 7 kHz tone is no laughing matter, especially when it lasts for three days.

The allowance, as they say in Italian, is *forte ma non troppo*—loud but not too much. The National Institute for Occupational Safety and Health in the USA recommends that sound exposure to 85 dBSPL should not exceed eight hours per day, halving the time for each 3 dB increase. A quick calculation reveals that it is only safe to listen to 100 dBSPL for 15 minutes. A screaming child a meter away is roughly 85 dBSPL. A subway train one meter away produces roughly 100 dBSPL when cruising at normal speed.

I have done my best to keep any audio samples at relatively consistent levels. Still, some samples had to be louder than others. Please mind your monitoring level when listening to these samples. Remember that too quiet can easily be made louder, but it might be too late to turn down levels once they are too loud.

Why we like loud levels so much is explained in Chapter 2. But if we are all to keep enjoying music, all we have to do is be sensible about the levels at which we mix and listen to music.

Levels, like alcohol, are best enjoyed responsibly.

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Part I

Concepts and practices

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1 Music and mixing

Music: An extremely short introduction

You love music. All of us are mixing because music is one of our greatest passions, if not *the* greatest. Whether starting as a songwriter, bedroom producer, performer, or studio tea boy, we were all introduced to mixing through our love of music and the desire to take part in its creation.

Modern technology dictates, to some extent at least, how we go about our life: we watch more and read less, we message more and talk less, we look at our smartphones more and less at one another. As far as music is concerned, new technologies have provided new opportunities, increased reach, and improved quality. The invention of the wax cylinder, radio transmission, tapes, CDs, software plugins, iTunes, smartphones, and Spotify has made music more readily accessible, widely consumed, and easier to create. One of mankind's most influential inventions—the Internet—is perhaps music today's greatest catalyst. Nowadays, a computer or a smartphone is all one needs to browse and listen to music. Music is universal and all-encompassing. It is in our living rooms, in our cars, in malls, on our televisions, and in hairdressing salons.

There is a strong bond between music and mixing, and to understand it we should start by discussing the not-too-distant past. Sacred music dominated the Western world until the nineteenth century, with most compositions commissioned for religious purposes. Secular music has evolved throughout the years, but really took off with the arrival of Beethoven—a daring and innovative composer at the time, no doubt. But it was the way that his music made people *feel* that changed the course of music so dramatically. Ernest Newman once wrote about Beethoven's symphonies:

> *The music unfolds itself with perfect freedom; but it is so heart-searching because we know all the time it runs along the quickest nerves of our life, our struggles & aspirations & sufferings & exaltations*.[1]

We can easily identify with this when we think about modern music—there is no doubt it can have a huge impact on us. Following Beethoven, music became a love affair between two willing individuals—the artist and the listener—fueled by what is today an inseparable part of music: emotions.

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Today, music rarely fails to trigger emotions—all but a few pieces of music have some sort of mental or physical effect on us. "Killing in the Name" by Rage Against the Machine can trigger a feeling of rage or rebellious anger. Others find it hard to remain stationary when they hear "Hey Ya!" by OutKast. Music can turn a bad morning into a good one. Music can also trigger sad or happy memories, and so the same good morning can turn into a more retrospective afternoon after hearing Albinoni's "Adagio" (which goes to show that it's not just emotive lyrics that affect us).

As we shall soon see, our response to music mostly stems from our unconscious mind. Yet, we sometimes deliberately listen to music in order to incite a certain mood—some listen to ABBA as a warm-up for a night out, others to Iggy Pop. Motion-picture directors understand well how profoundly music can affect us and how it can be used to solicit certain emotional responses from the audience. We all know what kind of music to expect when a couple falls in love or when a shark is about to attack; it would be a particular genre of comedy that used "YMCA" during a funeral scene.

As mixing engineers, one of our prime functions, which is actually *our responsibility*, is to help deliver the emotional context of a musical piece. From the general mix plan to the smallest reverb nuances, the tools we use—and the way we use them—can all sharpen and even create power, aggression, softness, melancholy, psychedelia, and many other moods. Mostly, it would make little sense to distort the drums on a mellow love song, just as it would not be right to soften the beat of a hip-hop production. When approaching a new mix, we may ask ourselves:

- What is this song about?
- What emotions are involved?
- What message is the artist trying to convey?
- How can I support and enhance the song's vibe?
- How should the listener respond to this piece of music?

As basic as this idea might seem, it is imperative to comprehend—it is emotions that gel the music and mix together, not technical excellence.

A mix can, and should, enhance the music: its mood, the emotions it conveys, and the response it should incite.

The role and importance of the mix

A basic definition of mixing is: A process in which multitrack material—whether recorded, sampled, or synthesized—is balanced, treated, and combined into a multichannel format (most commonly, two-channel stereo). But a less technical definition would be: **a sonic presentation of emotions, creative ideas, performance, and musicianship**.

Even for the layperson, sonic quality does matter. Take talking on a cell phone, for example—people find it annoying when background noise masks the other party. Intelligibility is the most elementary requirement when it comes to sonic quality, but it goes far beyond that. Today's cell phones are hardly better than playback systems from the 1950s. It is no wonder that people prefer listening to music via their kitchen's mini-

system or the living room hi-fi. What would be the point of more expensive hi-fi systems if the sound quality were no better than a cell phone speaker?

Sonic quality is also a powerful selling point. It was a major contributor to the rise of the CD and the fall of compact cassettes. Novice classical music listeners often favor new recordings over older, monophonic ones, regardless of how acclaimed the performance on these early recordings is. Record companies issue digitally remastered versions of classic albums that allegedly sound better than the originals. The once-ubiquitous iPod owed much of its popularity to the MP3 format—no other lossy compression format has managed to produce audio files so small, yet of an acceptable sonic quality.

The majority of people appreciate sonic quality more than they realize.

It is our responsibility as mixing engineers to craft the sonic aspects of the final mix. This involves how different instruments combine, but also how each sounds—the whole and its parts. Let us consider for a moment the differences between studio and live recordings. During a live concert, there are no second chances. You are unable to rectify sloppy performance or a buzz from a faulty DI box. Both the recording equipment and the environment are inferior compared with those found in most studios—it would be unreason able to place Adele in front of a *U87* and a pop shield during a live show. Also, when a live recording is mixed on location, a smaller and cheaper arsenal of mixing equipment is used. All of these constraints could result in different instruments suffering from masking, poor definition, erratic dynamics, and deficient frequency response, to name just a few possible problems. Audio terms aside, these can translate into a barely audible bass guitar, honky lead vocals that come and go, a kick that lacks power, and cymbals that lack spark. Altogether, these can make a live recording less appealing. A studio recording is not immune to such problems, but in most cases it provides much better raw material to work with, and, in turn, better mixes. With all this in mind, the true art of mixing is far more than just making things sound right …

Many people are familiar with Kurt Cobain, Dave Grohl, and Krist Novoselic as the band members of Nirvana, who, back in 1991, changed the face of alternative rock with the release of *Nevermind*. The name Butch Vig might ring a bell for some, but the general public will be unlikely to have heard of Andy Wallace. The front cover of my *Kill Bill* DVD makes it extremely difficult to ignore Tarantino's writer and director credits. But it is seldom that an album cover credits the producer, let alone the mixing engineer. Arguably, the production of Dr. Dre can be just as important as the artists he produces, and perhaps *Nevermind* would have never been such an enormous success had it not been for Andy Wallace's mixes. Nevertheless, record labels generally see very little marketing potential in production personnel. Ironically, major record companies do part with large sums of cash in order to have a specific engineer mix an album because they all realize that:

The mix plays an enormous role in an album or track's success.

To understand why, one may wish to compare Butch Vig's and Andy Wallace's mixes for Nirvana's "Smells Like Teen Spirit" (both can easily be found online through streaming services).

Both Vig and Wallace used the same raw tracks, yet their mixes are distinctly different. Vig's mix entails some unbalanced frequency spectrum that involves masking and the absence of spark; a few mixing elements, such as the snare reverb, are easily discernible. Wallace's mix is burnished and balanced; it boasts high definition and perfect separation between instruments; the ambiance is present, but like many mixing elements it is subtle.

Perhaps the most important difference between the two mixes is that Vig's mix sounds more natural (more like a live performance), while Wallace's mix sounds more artificial. It is not equipment, time spent, or magic tricks that made these two mixes so dissimilar—it is simply two different sonic visions. Vig has opted for the real and organic, whereas Wallace, a sonic alchemist who was perfecting his polishing skills at the time, combined every aspect of this powerful song into an extremely appealing masterpiece, albeit not a live-sounding one. Like many other listeners, Gary Gersh—Geffen Records' A&R—liked it better.

Straight after recording *Nevermind*, it was Vig that started mixing the album. Having spent countless hours in the recording studio listening to the same songs, it is common for a producer to wear out and develop sonic biases. A tight schedule and some artistic disagreements with Cobain left everyone (including Vig) feeling that it would be wise to bring fresh ears in to mix the album. From the bottom of the prospective engineers list, Cobain chose Wallace, mostly due to his mixing credits for Slayer. Despite Nirvana approving the mixes, following *Nevermind*'s extraordinary success, Cobain complained that the overall sound of *Nevermind* was too slick—perhaps suggesting that Wallace's mixes were too listener-friendly for his somewhat anarchic and unrefined taste. Artistic disagreements are something engineers come across often, especially if they ignore the artist's musical values. Yet, some suggested that Cobain's retroactive complaint was only a mis-targeted reaction to the massive success and sudden fame the album brought. Not only did *Nevermind* leave its mark on music history; it also left a mark on mixing history—its sonic legacy, a part of what is regarded as the *Wallace sound*, is still an aspiration for many today. As testament to Wallace's skill, *Nevermind* has aged incredibly well and still impresses despite enormous advances in mixing technology.

The example above is just one of many that demonstrate how a good mix can sharpen the emotional message of a musical piece, make it more appealing to the listener, and boost commercial success. Conversely, a bad mix can negatively affect a potentially great production and significantly impair its chance of success. This is not only relevant for commercial releases. The price and quality of today's DAWs enable unsigned artists and bedroom producers—given sufficient dedication—to craft mixes that are of an equal standard to commercial mixes. For quite some time now, A&Rs are receiving demos of a respectable mix quality. Just as a studio manager might filter through a pile of CVs and eliminate candidates based on poor presentation, an A&R might dismiss a demo for its poor mix.

Mixing engineers know what a dramatic effect mixing can have on the final product. With the right amount of effort, even the poorest recording can be made appealing. Yet, there are a few things we cannot do; for example: correct a truly bad performance, compensate for a very poor production, or alter musical ideas. If the piece does not

have potential to begin with, it will fail to impress the listener, no matter how noteworthy the mix is.

A mix is as good as the song.

The perfect mix

It doesn't take much experience before the novice mixer can begin to recognize problems in a mix. For instance, we quickly learn to identify vocals that are too quiet or a deficient frequency response. We will soon see that, once a mix is problem-free, there are still many things we can do in order to make it better. The key question is: What is better?

At this point, I recommend an exercise called **excerpt set** (Figure 1.1)—an essential mixing experiment. It takes around half an hour to prepare, but provides a vital mixing lesson. The excerpt set is very similar to a DJ set, except each track plays for around 20 seconds and you do not have to beat-match. Simply import around 20 songs from your music library into your audio sequencer. Then trim a random excerpt of 20 seconds from each track and arrange the excerpts consecutively. It is important to balance the perceived level of all excerpts, and cross-fade them. Now listen to your set, beginning to end, and notice the differences between the mixes; these differences are highly likely to be great. You might also learn that mixes you thought were good are not as good when played before or after another mix. While listening, try to note mixes that *you* think overpower others. This exercise will help develop a heightened awareness of what a good mix is and why.

Most of us do not have a permanent sonic standard stored in our brains, so a mix is only better or worse than the previously played mix. The very same mix can sound dull compared with one mix but bright compared with another. (With experience, we develop the ability to critically assess mixes without the need for a reference, although usually only in a familiar listening environment.) In addition, our auditory system has a very quick settle-in time, and it becomes accustomed to different sonic qualities so long as these remain constant for a while. In essence, all our senses work that way—a black-and-white scene in a color movie is more noticeable than the lack of color on a black-and-white TV. The reason why the excerpt set is such an excellent tool for revealing differences is that it does not give the brain a chance to settle in to a particular style. When mixes are played in quick succession, we can more easily perceive the sonic differences between them.

Different engineers have different ideas and mix in different environments, and therefore produce different mixes. Our ears are able to tolerate radical differences as long as mixes are not heard in quick succession. It is hard to find two albums that share an identical sound because different genres are mixed differently—jazz, grime, and trance will rarely share the same mixing philosophy; different songs involve different emotions and therefore call for different soundscapes; and the quality and nature of the raw tracks vary between projects. But we shouldn't forget that each mixing engineer is an artist in their own right, and each has different visions and ideas about what's best. Asking what is a perfect mix is like asking who is the best writer that ever lived, or who is the greatest basketball player of all time—it is subjective, situational, and highly contextual.

Figure 1.1 Excerpt set. This sequence of 20-second excerpts from various productions is used as an important comparison tool between mixes.

Mixing engineers will often adjust their style depending on the project. One example is Rich Costey, who mixed Muse's Absolution, *imbuing it with a very polished feel. He later produced Franz Ferdinand's* You Could Have It So Much Better, *taking a much rawer mixing approach with a distinctly retro feel. His mixes on Glasvegas's debut album are anthemic and sharp-sounding, featuring dominant reverbs typical of mixes from the 1980s*. Humbug *by Arctic Monkeys feels dark and beefy and features a contemporary sound with retro touches. Each of these different mixing approaches works a charm for its respective album*.

Note

1 Allis, Michael (2004). Elgar, Lytton, and The Piano Quintet, Op. 84. *Music & Letters*, Vol. 85 No. 2, pp. 198–238. Oxford University Press. Originally a letter from Newman to Elgar, January 30, 1919.

2 Some axioms and other gems

Louder is better

In 1933, two researchers at Bell Labs—Harvey Fletcher and W.A. Munson—conducted one of the most significant experiments in psychoacoustics. Their experiment was based on a series of tests taken by a group of listeners. Each test involved playing a test frequency followed by a reference tone of 1 kHz. The listener simply had to choose which of the two was louder. Successive tests involved either a different test frequency or different levels. Essentially, what Fletcher and Munson tried to conclude is how louder or softer different frequencies had to be in order to be perceived as loud as 1 kHz. They compiled their results and devised a chart known as the *Fletcher–Munson curves*. A chart based on the original Fletcher–Munson study is shown in Figure 2.1. I am presenting it upside down, as it bears a resemblance to the familiar frequency-response graphs that we see on some equalizers, with peaks at the top. A similar experiment was conducted two decades later by Robinson and Dadson (resulting in the *Robinson–Dadson contours*), and today we use the ISO 226 standard (which is still subject to occasional revisions). The formal name for the outcome of these studies is *equal-loudness contours*.

Each curve in Figure 2.1 is known as a *phon curve*, labeled by the level of the 1 kHz reference. To give an example of how to read this chart, we can follow the 20-phon curve and see that, if 1 kHz is played at 20 dBSPL, 100 Hz would need to be played at 50 dBSPL in order to appear equally loud (a 30 dB difference, which is by no means marginal). The graph also teaches us that our frequency perception has a bump around 3.5 kHz—this is due to the resonant frequency of our ear canal. Interestingly, this is pretty much the center frequency of a baby's cry.

One important thing that the equal-loudness contours teach us is that we are more sensitive to mid-frequencies—an outcome of the lows and highs roll-off that can be seen on the various curves. But more importantly, it is evident that at louder levels our frequency perception becomes more even—the 0-phon curve in Figure 2.1 is the least flat of all the curves; the 100-phon curve is the most even. Another way to look at this is that the louder music is played, the louder the lows and highs are perceived. In extremely general terms, we associate lows with power and highs with definition, clarity, and spark. So it is only natural that loud levels make music more appealing—louder is perceived as better.

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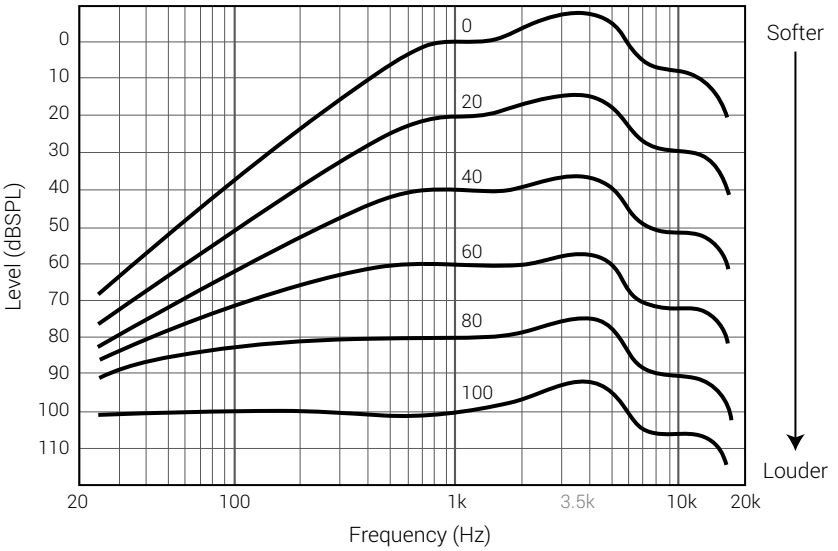

Figure 2.1 The Fletcher–Munson curves (shown here upside down). Note that on the level axis, soft levels are at the top, loud at the bottom.

This phenomenon explains the ever-rising level syndrome that many experience while mixing: once levels go up, it is no fun bringing them down. The more experienced among us develop the discipline to defeat this syndrome by keeping levels constant.

The louder music is played, the more lows and highs we perceive compared with mids.

The latest ISO 226 contours are slightly different than those shown in Figure 2.1*; they show an additional bump around 12 kHz and a steeper low-frequency roll-off, which also occurs on the louder phon curves.*

The fact that our frequency perception alters in relation to levels is a fundamental mixing issue. How are we supposed to craft a balanced mix if the frequency content varies with level? At what level should we mix? And what will happen when the listener plays the track at different levels? The answer is: we check our mix at different levels, and try to make it as level-proof as possible. We know what to expect when we listen at softer levels—less highs and lows. It is possible to equalize the different instruments so that even when the highs and lows are softened, the overall balance between instruments hardly changes. For example, if the kick's presence is based solely on low frequencies, it will be heard less at quiet levels, if at all. If we ensure that the kick is also present on the high-mids, it will be heard much better at quiet levels. Many believe that the mids, which vary little with level, are the key to a balanced mix, and if the lows and highs are crafted as an extension to the mids, a mix will exhibit more stable balance at different levels. Also, many agree that if a mix sounds good when at low levels, it is likely to sound good when played loud; the opposite is not always true. Another pointer is that we can sometimes guess the rough level at which the mix is likely to be played

(e.g., dance music is likely to be played louder than ambient), and so we can use that level as the main reference while mixing (as reference means occasionally—mixing at nightclub levels throughout is next to certain to damage your ears).

> *Two common adages: The mids are the key to a balanced mix at varying levels. A mix that sounds good at quiet levels is likely to sound good at loud levels.*

There is another reason why louder is perceived as better. When listening at soft levels, we hear more of the direct sound coming from the speakers and less of the sound reflected from the walls (i.e., the room response). Sound energy is absorbed, mostly as it encounters a surface. The small amount of energy our speakers emit at quiet levels is absorbed by walls to a degree that only a fraction of it reflects back to our ears. At louder levels, more energy is reflected and we start hearing more of the room response. As a consequence, the louder music is played, the more we hear the reflections coming from around us, which provides us with the appealing sensation that the music surrounds us. There is an experiment you can do to demonstrate this effect, which might be more apparent with eyes shut—play a mix at quiet levels through speakers and try to define the spatial boundary of the sound image. Most people will imagine a line, or a very short rectangle between the two speakers. As the music is made louder, the sound image grows, and at some point the two-dimensional rectangle turns into a vague surrounding sense.

When making individual instruments louder in the mix, we perceive them better. The core reason for this is masking—the ability of one sound to cover up another. More specifically, the frequency ranges of one instrument mask those of another. One of the principal rules of masking is that louder sounds overpower quieter sounds. The higher the level of an instrument in the mix, the more it will tend to mask other instruments, and the more clearly it will be perceived. When focusing on a particular instrument, it is tempting to bring it up to hear it better, and once up it is likely to sound better. This may be misleading and lead to suboptimal balance.

Percussives weigh less

It is important to distinguish the different natures of the instruments we are mixing. An important mix resource is space; when different instruments are combined, they compete for that space (mostly due to masking). Percussive instruments come and go—a kick, for example, has little to no sound between various hits. Percussives fight for space in successive, time-limited periods. On the other hand, sustain instruments play over longer periods and thus constantly fight for space. To give one extreme example, think of a rich pad produced using sawtooths (the most harmonically rich orderly waveform) that involves unison (an effect that spreads copies across the stereo image), and played in a legato fashion (long notes). Such a pad would fill both the frequency spectrum and the stereo panorama in a way that is most likely to mask many other elements in the mix.

In a practical sense, sustained instruments require somewhat more attention. Whether we are setting levels, panning, or equalizing them, our actions will have an effect over a longer period. Raising the level of a dense pad is likely to cause more masking problems than raising the level of a kick. If the kick masks the pad, it would only do so for

short periods—perhaps not such a big deal. But if the pad masks the kick, it would do so constantly—a big deal indeed.

Importance

Imagine yourself being on a *Seinfeld* set. In the scene being shot, Jerry and Kramer stand in a long line of people at a box office, engaged in conversation. Being the stars of the show, among all people, the production efforts would have been focused on the two stars. The makeup artist, for example, probably spent quite some time with them, perhaps little time with the extras standing next to them, and most likely no time with any other extras standing farther away in the line. In the camera shot, Jerry and Kramer are seen clearly in the center and extras are out of focus. The importance of the stars will also have been evident in the work of the gaffer, the grips, the boom operator, or any other crew member, even the chef.

Equally, different mix elements have varying importance within the mix. The importance of each instrument depends on many factors, like the nature of the production being mixed. In hip-hop, for example, the beat and vocals are generally the most important elements. In jazz, the snare is more important than the kick. Spatial effects are an important part of ambient music. A prominent kick is central to club music, but of far less importance in most folk music. Many more examples can be given. We also have to consider the nature of each instrument and its role in the overall musical context. Vocals, for example, are often of prime importance, but the actual lyrics also play a crucial role. The lyrics of Frank Sinatra's "My Way" are vital to the song's impact, and mixing a vocal part as such calls for more emphasis. Arguably, the lyrics to "Give It Away" by Red Hot Chili Peppers are of little importance to the overall song climate.

Importance affects how we mix different elements, be it levels, frequencies, panning, or depth we are working on. We will shortly look at how the order in which we mix different instruments and sections may also be affected. Identifying importance can make the mixing process all the more effective as it minimizes the likelihood of delving into unnecessary or less important tasks—for example, spending a fair amount of time on treating pads that only play for a short period of time at relatively low level. Those of us who mix under time constraints have to prioritize our tasks. In extreme circumstances, you might have as little as one hour to mix the drums, just half an hour for the vocals, and so on.

A useful question: How important is it?

Natural vs. artificial

A specific event that took place back in 1947 changed the course of music production forever. Patti Page, then an unknown singer, arrived at a studio to record a song called "Confess." The studio was set up in the standard way for that era, with all the performers in the same room, waiting to cut the song live. But there was a problem—"Confess" was a duet where two voices overlap, but for a reason yet to be found, no second vocalist showed up. Jack Rael, Page's manager, came up with the unthinkable:

Patti could sing the second voice as well, provided the engineer could find a way to *overdub* her voice. Legend has it that at that point, the engineer cried in horror: in real life, no person can sing two voices at the very same time. It's ridiculous. Unnatural! But to the A&R guy from Mercury Records, this seemed like a great gimmick that could secure a hit. To achieve this, the engineer did something that was never done before—cloning the track from one machine to another while adding the second voice on top. What then seemed so bizarre is today an integral part of music production.

For our purposes, a "natural" sound is one that emanates from an instrument that is played in our presence. If there are any deficiencies with the raw recordings (which capture the natural sound), various mixing tools can be employed to make instruments sound "more natural." A mix is considered more natural if it presents a realistic sound stage (among other natural characteristics). If natural is our goal, it would make no sense to position the kick up front and the rest of the drum kit behind it.

However, natural is not always best—natural can also be seen as very ordinary. Early on in photography, it occurred to people that shadows, despite being such a natural part of our daily life, impair visuals. Most advertisements have had tone and color enhancements in order to make them look "better than life." The same goes for studio recording. It is not uncommon today to place the kick in front of the drum kit, despite the fact that this creates a very unnatural spatial arrangement.

One of the principal decisions we make when we began a mix is whether we want things to sound natural or artificial. This applies on both the mix and instrument levels. Some mixes call for a more natural approach. Jazz enthusiasts, for example, expect a natural sound stage and natural-sounding instruments, although in recent years more and more jazz mixes involve an unnatural approach—for instance, compressed drums with an emphasized kick and snare. This fresh, contemporary sound has attracted a new audience (and even some connoisseurs), and facilitated a wider market for record companies to exploit. Popular music nowadays tends to be all but natural—the use of heavy compression, distortions, aggressive filtering, artificial reverbs, delays, distorted spatial images, and the like is routine. These paradigms, while not natural, increase the potential for creativity and profoundly affect the overall sound. Mixes are sonic illusions. The same way that color enhancement improves visuals, our mixing tools allow us to craft illusions that sound better or just different from real life. People who buy live albums expect a natural sound. Those who buy studio albums expect, to some extent, a sonic illusion, even if they don't always realize that.

Some inexperienced engineers are hesitant to process since they consider the raw recording a natural touchstone. Often they are cautious about even gentle processing, considering it to be harmful. Listening to a commercial track that was mixed with an artificial approach will reveal just how extreme mixing treatments can be. Take vocals, for example: their body might be removed, they might be compressed so that there are no dynamic variations, or they might be overtly distorted. We have to remember that radical mixing is generally unperceived by those without a trained ear—the majority of listeners, that is. Here are three sentences my mother has never said and will probably never say:

- Listen to her voice. It's over-compressed.
- That guitar is missing body.
- The snare is too loud.

The common listener does not think or speak using these terms. For them, it is either exciting or boring; they either feel it or don't; and most importantly, they either like it or they don't. This leaves a lot of room for wild and adventurous mixing treatments—we can filter the hell out of a guitar's bottom end; people will not notice. We can make a snare sound like a Bruce Lee punch; people will not notice. Just to prove a point here, the verse kick on Nirvana's "Smells Like Teen Spirit" reminds me more of a bouncing basketball than any bass drum I have ever heard playing in front of me. People do not notice.

3 Learning to mix

An analogy can be made between the process of learning a new language and that of learning to mix. At the beginning, nothing seems to make sense. With language, you are unable to understand simple sentences or even separate the words within a sentence. Similarly, if you play a mix to most people, they will not be able to hear a reverb or compression as they haven't focused on these sonic aspects before, let alone used reverbs or compressors. After learning some individual words and how to use them, you find yourself able to identify them in a sentence; in the same way, you start learning how to use compressors and reverbs and then learn to recognize them in mixes. Pronouncing a new word can be challenging, since it is not easy to notice the subtle pronunciation differences in a new language, but after hearing and repeating a word 20 times, you get it right; likewise, after compressing 20 vocal tracks, you will start to identify degrees of compression and quickly evaluate what compression is most suitable. Then you will begin to learn grammar so that you can begin to connect words together and construct coherent sentences, much like all your mixing techniques help you to craft a mix as a whole. Finally, since conversation involves more than one sentence, the richer your vocabulary is and the stronger your grammar, the more sentences you are able to properly construct. In mixing, the more techniques and tools you learn and the more mixes you craft, the better your mixing becomes. Practice makes perfect.

What makes a great mixing engineer?

World-class mixing engineers might earn more for a single album than many people earn in a year. Some mixing engineers also receive points—a percentage from album sale revenue. On both sides of the Atlantic, an accomplished mixing engineer can enjoy a six-digit annual revenue. These individuals are being remunerated for their knowledge, experience, and skill. Record labels reward them for that, and in exchange enjoy greater sales.

It is clear why mixing is often done by a specialized person. And it is such a vast area that it is no wonder some people devote themselves entirely to it—the amount of *knowledge* and *practice* required to make a great mixing engineer is vast.

Primarily, the creative part of mixing revolves around the three steps shown in Figure 3.1. The ability to progress through these steps can lead to an outstanding mix.

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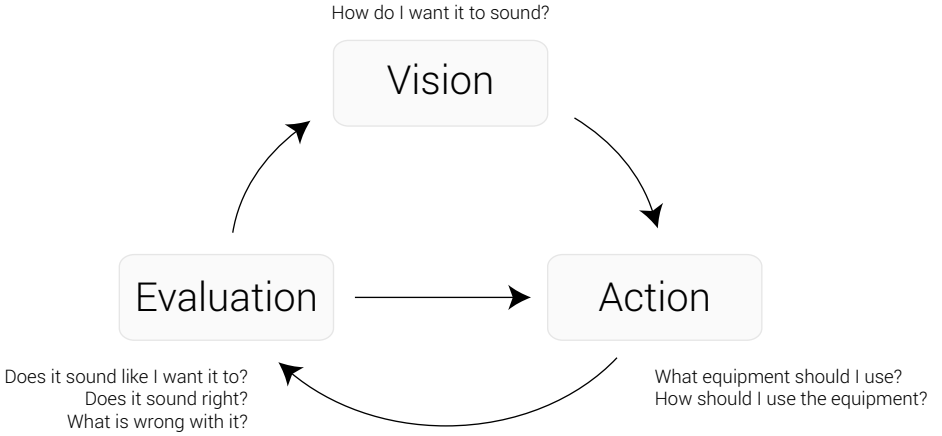


Figure 3.1 The three steps of creative mixing.

But a great mixing engineer will need a notch more than that, especially if hired. These steps are explained, along with the requisite qualities that make a great mixing engineer, in the following sections.

Mixing vision

There are different methods of composing. One involves using an instrument, say a piano, and then, either by means of trial and error or using music theory, coming up with a chord structure and melody lines. Another approach involves imagining or thinking of a specific chord or melody and then playing it. The latter process of "visualizing" and then playing or writing is favored by many composers and songwriters.

The same two approaches apply to mixing as well. If we take the equalization process of a snare, for example, the first approach involves sweeping through the frequencies, then choosing whatever frequency appeals to us most. The second approach involves first imagining the desired sound and then approaching the EQ in order to attain it. Put another way, the first approach might involve thinking, "OK, let's try to boost this frequency and see what happens," while the second might sound more like, "I can imagine the snare having less body and sounding more crisp." Just as some composers can imagine the music before they hear it, a mixing engineer can imagine sounds before attaining them—a big part of mixing vision. Mixing vision is primarily concerned with the fundamental question: **How do I want it to sound?** The answer could be soft, powerful, clean, etc. But mixing vision cannot be defined by words alone—it is a sonic visualization, which later manifests through the process of mixing.

The selection of tools that we can use to alter and embellish sound is massive—equalizing, compressing, gating, distorting, adding reverb or chorus are just a few. So what type of treatment should we use? There are infinite options available to us within each category—the frequency, gain, and Q controls on a parametric equalizer provide billions of possible combinations. So why should we choose a specific combination and not another? Surely equalizing something in a way that makes it sound right does not mean that a different equal ization would not make it sound better. A mixing vision provides the answer to these questions: "because this is how I imagined it; this is how I wanted it to sound."

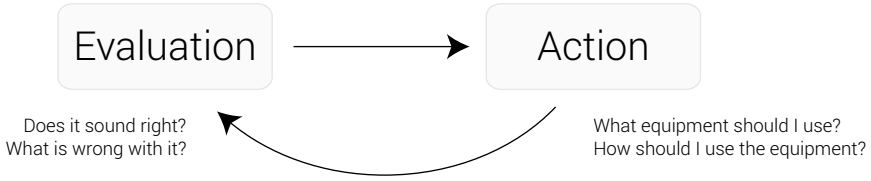


Figure 3.2 The novice approach, without a mixing vision.

A novice engineer might lack imagination. The process of mixing for him or her is a trial-and-error affair between acting and evaluating (Figure 3.2). But how can one critically evaluate something without a clear idea of what one wants in the first place? Having no mixing vision can make mixing a very frustrating hit-or-miss process.

Having a mixing vision can make all the difference between the novice and the professional mixing engineer. While the novice shapes the sounds by trial and error, the professional imagines sounds and then achieves them.

The skill to evaluate sounds

The ability to craft a good mix is based on repeated **evaluations**. One basic question, often asked at the beginning of the mixing process, is **"What's wrong with it?"** Possible answers might be, "the highs on the cymbals are harsh," "the frequency spectrum of the mix is too heavy on the mids," or "the drums are not powerful enough." From the endless amount of treatment possibilities we have, focusing on rectifying the wrongs provides a good starting point. It can also prevent the novice from doing things that aren't actually necessary (for example, equalizing something that didn't really require equalization) and thereby save precious studio time.

At times, it might be hard to tell what is wrong with the mix, in which case our mixing vision provides the basis for our actions. After applying a specific treatment, the novice might ask, **"Does it sound right?"** while the veteran might also ask, **"Does it sound the way I want it to?"** Clearly, the veteran has an advantage here since this question is less abstract.

Mastering the tools and knowledge of other common tools

Whether with or without a clear mixing vision, we perform many **actions** in order to alter sounds. When choosing a reverb for vocals, the novice might tirelessly go through all the available presets on a reverb emulator. There can be upwards of 50 of these, and so the entire process can take some time. The veteran, on the other hand, will probably quickly access a specific emulator and choose a familiar preset; a bit of tweaking and the task is done. It takes very little time. Experienced mixing engineers know, or can very quickly find out, which tool will do the best job in a specific situation. They can quickly answer the question: **"What equipment should I use?"**

Professional mixing engineers do not always work in their native environment. They will sometimes work in different studios and, even though they might take their favorite gear with them, a big part of the mix will be done using in-house equipment.

Therefore, professional mixing engineers have to be familiar with the common tools found in a commercial environment.

Mastering the tools at one's disposal does not only mean having the ability to pick the right tool for a specific task, but also having the expertise to employ the equipment in the best way (**"How should I use the equipment?"**). Knowing whether to choose high-shelving or high-pass characteristics on an equalizer, or knowing that a specific compressor will work well on drums when more than one ratio button is pressed, are just a couple of examples.

It is also worth discussing the quantity of tools we have at our disposal. Nowadays, DAW users have a wider selection than those mixing using hardware. Not only are plugins cheaper, but they can be used across various tracks, simultaneously, whereas a specific hardware processor cannot. In an analog studio, a mixing engineer might have around three favorite compressors to choose from when processing vocals; DAW users might have a choice of 10. Learning each of these compressors—*understanding* each of them—takes time. Just reading the manual is time-consuming. Having many tools can mean that they are not realizing their potential because there is no time to learn and properly experiment with them all. Mixing is a simple process that only requires a pair of trained ears and a few quality tools. Less can be more.

Jack of all trades, master of none.

Theoretical knowledge

Four questions:

- When clipping shows on the master track in an audio sequencer, is it the master fader or all of the channel faders that should be brought down?
- To achieve more realistic results, should one or many reverb emulators be used?
- Why and when should stereo linking be engaged on a compressor?
- When should dither be applied?

To say that every mixing engineer knows the answers to these questions would be naïve. The same could be said that one cannot craft an outstanding mix without strong theoretical knowledge. There are more than a few highly successful engineers who would be unable to provide answers to many theoretical questions relating to their field. But knowing the answers to these questions is definitely an advantage. Knowledge is always a blessing and, in such a competitive field, can make all the difference. Out of two equally talented engineers with different levels of knowledge, it would not be difficult to choose who to work with.

To acquire knowledge, some might undertake an educational program while others might learn little by little on the job; but, either way, all mixing enthusiasts need to be compulsive learners—if the ratio on a compressor is set to 1:1, a novice will spend hours trying to figure out why no other control has an effect. Learning the difference between shelving and a pass filter is handy. The effect that dither has on the final mix quality is worth knowing. It would seem unreasonable for a mastering engineer not to know when to apply dither, but mixing engineers should know too.

It is better to know what you can do, and how to do it, than to understand what you have done.

Interpersonal skills

Studio producers need an enormous capacity to interact and deal with many people, with different abilities, moods, and degrees of dedication. Mixing engineers tend to work on their own and only occasionally mix in front of the client—whether that is the artist, A&R, or the producer. So, although to a lesser extent than a studio producer, like any job that involves interaction with people, mixing also requires good interpersonal skills.

When the band comes to listen to the mix, it should not come as a surprise that each band member will insist that his or her instrument is not loud enough. (In their defense, they are used to their instrument appearing louder to them, whether onstage or through the cans in the live room.) Even the old tricks of limiting the mix or blasting the full-range speakers will not always appease them. On many occasions, artists and A&R remark on the work of mixing engineers with the same rationale of accountants commenting on the work of graphic designers they have hired.

While the feedback from fresh ears can sometimes be surprisingly constructive, at times the clients' comments are either technically or artistically naïve or inappropriate. Things can easily become personal—mixing engineers, like the artists they mix, can become extremely protective about their work. Interpersonal skills can help avoid or resolve artistic disagreements, and assist with calmly expressing an opinion. But if the artist does not like some aspect of the mix, even if it's technically earth-shattering, however much the mixing engineer might disagree, it is the mixing engineer who must compromise. The client-is-always-right law is the same in mixing—after all, a displeased client is a lost client. For artists, each single or album goes on their CV forever and can be life-defining. Do you really want them to be unhappy with your work?

The ability to work fast

Learning something new can be tricky and testing—all guitar players experience some frustration before they can change chords quickly enough or produce a clean sound. It is maddening working on a single verse for a whole day and still being unhappy with the mix. But, as experience accumulates, it takes less time to choose tools and utilize them to achieve the desired sound. Also, our mixing visions become sharper and we can crystallize them more quickly. Altogether, each task takes less time, which leaves more time to elevate the mix or experiment. Needless to say, the ability to work fast is essential for hired mixing engineers, who work under busy schedules and strict deadlines.

Methods of learning

Reading about mixing

Literature is great. Books, magazine articles, and Internet forums can be the source of some extremely valuable theory, concepts, ideas, and tips. But reading about mixing

will not make a great mixing engineer, in the same way as reading a cookery book will not make a great chef. Reading about mixing gives us a better chance to understand core concepts and operate our tools, but the one thing it does not do is improve our sonic skills.

Reading manuals is also important, although unfortunately many people choose to neglect it. The basic aim of a manual is to teach us how to use our equipment, and sometimes also how to use it correctly or how to use it better. In their manuals, many manufacturers will present some practical advice on their products and sometimes on mixing in general. Sometimes the controls of a certain tool are not straightforward and it might take an eternity to understand what its function is without reading the manual.

Read the manual.

Reading and hearing

This book is an example of this method. An aural demonstration of mixing-related issues provides a chance to develop critical evaluation skills and better understanding of sonic concepts. While this method can contribute to all stages of mixing—vision, action, and evaluation—it is a passive way of learning since it does not involve active mixing.

Seeing and hearing

Watching other people mix is another way to learn. Many people want to work in a studio so they can learn from the experienced. Listening to others while they apply their expertise to a mix is a great opportunity and a valuable experience, but comes with two cautions. First, it is impossible to enter other people's minds—while watching them mix it might be possible to understand what they are doing, but not why they are doing it. **Mixing vision and experience are nontransferable**. Second, if we take into account the tricks and tips already published, what is left to learn from these experienced people is mostly their own unique techniques. True, learning the secret techniques of mixing engineers at the top of their game is great, but only if these are used in the right context. There is the belief that the greatest mixing engineers produce incredible mixes because of secret techniques. In practice, these amazing mixes are not down to secret techniques, but to an **extensive understanding of basic techniques and experience using them**. Secret techniques often only add a degree of polish or the individual's idiosyncratic sonic stamp.

Doing it

Without a shadow of a doubt, the best way to learn mixing is simply by doing it. Most of the critical skills and qualities of a great mixing engineer can be acquired through the practice of the art. While mixing, we learn to evaluate sounds and devices, use our equipment in the best way, work faster, and articulate our mixing vision quicker. Combined with good theoretical background and enough application, there is very little to stop anyone from becoming a competent mixing engineer. There is a direct link between mixing-miles and the final quality of the mix.

The best way to learn mixing is to mix.

Mixing analysis

Sometimes, learning the techniques of an art makes it hard to perceive the art as a whole. For example, while watching a movie, film students will analyze camera movements, lighting, edits, lip-sync, or acting skills. It can be hard for those students to stop analyzing and just enjoy movies like they did when they were fascinated kids. However, many mixing engineers find it easy to switch in and out from a mixing analysis state—even after many years of mixing, they still find it possible to listen to a musical piece without calculating how long the reverb is, where the trumpet is panned to, or questioning the sound of the kick. Others simply cannot help it.

Although it is far less enjoyable to analyze the technical aspects of a movie while watching it, this critical awareness can help make film students more conscientious filmmakers. Sit, watch, and learn how the masters did it—simple. The same approach works for mixing. Every single mix out there, whether good or bad, is a lesson in mixing. Learning is just a matter of pressing play and actively listening to what has been done. Although mixing analysis cannot always reveal how things were done, it can reveal much of what was done.

Your music collection contains hundreds of mixing lessons.

There are endless things to listen for when analyzing others' mixes, and these can cover any and every aspect of the mix. Here are just a few questions you might ask yourself while listening:

- How loud are the instruments in relation to one another?
- How are the instruments panned?
- How do the different instruments appear in the frequency spectrum?
- How far apart are the instruments in the depth field?
- How much compression was applied to the different instruments?
- Can any automation be detected?
- How long are the reverbs?
- How defined are the instruments?
- How do different mix aspects change as the song advances?

A quick demonstration seems appropriate here. The following points provide a partial mixing analysis for the first 30 seconds of Nirvana's "Smells Like Teen Spirit," the album version:

- The tail of the reverb on the crunchy guitar is audible straight after the first chord (0:01).
- There is extraneous guitar noise coming from the right channel just before the drums are introduced (0:05).
- The crunchy guitar dives in level when the drums are introduced (0:07).
- Along with the power guitars (0:09–0:25), the kick on the downbeats is louder than all other hits. (It appears to be the actual performance, but it can also be achieved artificially during mixdown.)
- When listening in mono, the power guitars lose some highs (0:09–0:25).
- The snare reverb changes twice (a particular reverb before 0:09, then no audible reverb until 0:25, then another reverb).

- During the verse, all the kicks have the same timbre (suggesting drum triggers).
- There is kick reverb during the verse.
- It is possible to hear a left/right delay on the hi-hats—especially during open/close hits. (This could be the outcome of a spaced microphone technique, but can also occur during mixdown.)
- The drums are panned audience-view.

The excerpt set (from Chapter 1) can be a true asset when it comes to mixing analysis, as the quick changes from one mix to another make many aspects more noticeable. Not every aspect of the mix is easily discernible: some are subliminal and are felt rather than heard. To be sure, the more time and practice we put into mixing analysis, the more we discover.

In addition to what we can hear from the plain mix, it is also possible to use different tools in order to reveal extra information. Muting one channel of the mix can disclose additional stereo information (e.g., a mono reverb panned to one extreme). Using a pass filter can help in understanding how things have been equalized. To reveal various stereo effects, one can listen in mono while phase-reversing one channel (this results in a mono version of the difference between the left and right, which tends to make reverbs and room ambiance very obvious).

Reference tracks

Mixing analysis is great, but it is impossible to learn hundreds of mixes thoroughly, and it can be impractical to carry them around just in case we need to refer to them. It is better to focus on a few select mixes, learn them inside out, analyze them scrupulously, and have them readily accessible.

Some mixing engineers carry a few reference tracks (mostly their own past mixes) so they can refer to them. The novice might refer to their reference tracks on a frequent basis. When mixing at home or in their studio, some have a specific folder on the hard drive with their select mixes.

In addition to reference tracks, including the excerpt set can be great since it enables a quick comparison between many different mixes. It is also possible to include a few raw tracks, which can later be used to evaluate different tools.

Our choice of reference tracks might not be suitable for every mix. If we are working on a mix that includes strings, and none of our reference tracks involve strings, it would be wise to look for a good mix that does. Likewise, if our reference tracks are all heavy metal and we happen to work on a chill-out production, it would be sensible to refer to some more appropriate mixes.

Usage of reference tracks

Reference tracks can be employed for different purposes:

- **As a source for imitation**—painting students often go to a museum to copy a familiar painting. While doing so, they learn the finest techniques of famous painters. Imitating another's techniques is part of the learning process. Likewise, there is nothing amiss in imitating proven mixing techniques—if you like the sound of the kick in a specific mix, why not imitate that sound in your mix? There is no reason why you can't replicate the technique of a specific track that you particularly like. When we are short of a mixing vision, we can replace it with the sonic image of an existing mix, or try to imitate it, or just some aspects of it. Trying to imitate the sound of a known mix is actually a great mixing exercise. However, caution must be exercised for several reasons. First, because productions can be so diverse that, whether in their emotional message, style, arrangement, quality, or nature of the raw material, what sounds good in another mix might not sound so good in yours. Second, setting a specific sound as an objective can be limiting and mean that nothing better will be achieved. Third, it is hard to obtain the same sounds with different recordings—when the ingredients are different, it's hard to make the dish taste similar. Finally, and most importantly, *imitation is innovation's greatest enemy*—there is little creativity involved in imitation. In fact, it might restrain the development of creative mixing skills.
- **As a source of inspiration**—while imitating a mix requires a constant comparison between the reference track and our own mix, reference tracks can be played before mixing to inspire us as to the direction in which the mix should go and what qualities it should incorporate. For the novice, such a practice can kick-start some mixing vision and set certain sonic objectives.
- **As an escape from a creative dead end**—sometimes we reach a point where we are clearly unhappy with our mix, but frustratingly cannot tell quite what is wrong with it. We might be simply out of ideas or lacking vision. Learning the difference between our mix and a specific reference mix can trigger new ideas, or suggest problems in our mix.
- **As a reference for a finished mix**—when we finish mixing, we can compare our mix to a specific reference track. Listening to how the professionals do it can help us generate ideas for improvement. The frequency response or relative levels of the two mixes are just two possible aspects that we might compare.
- **To calibrate our ears to different listening environments**—working anywhere but in our usual listening environment reduces our ability to evaluate what we hear. Just before we start to listen critically in an unfamiliar environment, whether mixing or just evaluating our own mixes, playing a mix we know well can help calibrate our ears to unfamiliar monitors, the acoustics, or even a different position within the same room.
- **To evaluate monitor models before purchase**—studio monitor retailers usually play customers a popular track that has an impressive mix, at loud levels. Chances are that the monitors will impress the listener that way. Listening to a mix that you are very familiar with can improve judgment.

It is worth remembering that if a reference track has been mastered, it is very likely to contain tighter dynamics, usually in the form of more allied relative levels and heavier compression. Also, mastered tracks are typically louder, whereas the overall loudness of a track is not a concern during the mixing stage. In some albums, frequency treatment takes place in order to match the overall sound to that of the worst track. These points are worth bearing in mind when comparing a reference track to a mix-in-progress—a mastered reference track is an altered version of a mix, usually for the better.

How to choose a reference track

Choosing some of our own past mixes for reference purposes is always a good idea. Having worked on these mixes, we are familiar with the finer details and, retrospectively, their faults. Ideally, reference materials should be a combination of both unmastered and commercial tracks. Here are a few of the qualities that reference tracks should have:

- **A good mix**—while subjective, your opinion of what is a good mix is central. It is important to choose a mix you like, not a production you like. Despite Elvis Presley's greatness, the sonic quality of his original albums is nowhere near today's standards.
- **A contemporary mix**—mixing has evolved. A good mix from the 1980s is likely to have more profound reverbs than the mix of a similar production from the 1990s. Part of the game is keeping up with the changing trends.
- **Genre related**—clearly, it makes little sense to choose a reference track of a genre that is fundamentally different from the genres you will be working on.
- **A dynamic production**—choosing a dynamic production, which has a dynamic arrangement and mix, can be like having three songs in one track. There is more to learn from such a production.

Reference tracks should not be:

- **A characteristic mix**—the mixing style of some bands, The Strokes, for example, is rather unique. A mix that has a distinct character will only serve those distinct productions and bands.
- **Too busy**—it is usually easier to discern mixing aspects in sparse productions.
- **Too simple**—the more there is to learn from a mix, the better. An arrangement made of a singer and their acoustic guitar might sound great, but will not teach you how to mix drums.

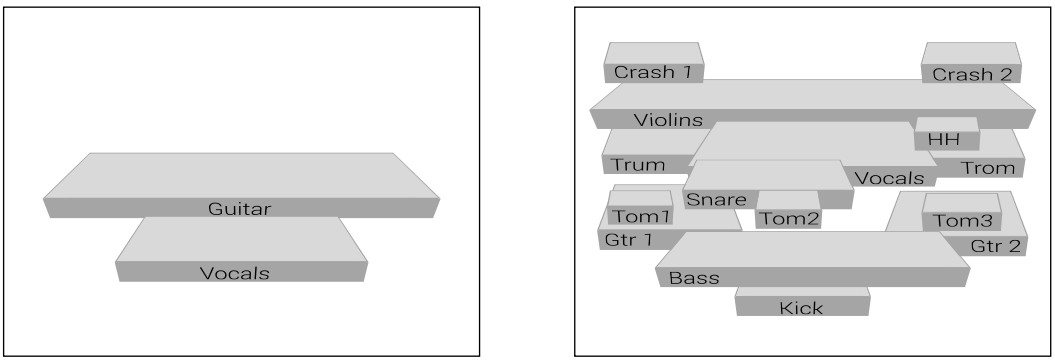
4 The process of mixing

The arrangement

The arrangement (or instrumentation) largely determines which instruments play, when, and how. An arrangement that lends itself to the mix will have its frequency, time, and stereo domains reasonably shared between its featured instruments.

Consider an arrangement that involves only one percussion instrument—a shaker. If panned center in a busy mix, it is most likely to be masked by other instruments; but panning it to one side can create an imbalanced stereo image. It might be easier for the mixing engineer to have a second percussion instrument, say a tambourine, so the two can be panned left and right. Then, if the shaker and tambourine are playing the same part, they will fight for the same space on the time and frequency domains, whereas if playing complementary parts, each should be more discernible.

One of the most relevant factors of the arrangement is its density. A sparse arrangement (Figure 4.1a) might call for a mix that fills various gaps in the frequency, stereo, and time domains. For example, an arrangement based solely on two tracks, an acoustic guitar and a vocal, could require creating something out of very little. At the other extreme, the challenge with a busy arrangement (Figure 4.1b) is often to create a



(a) (b)

Figure 4.1 Sparse vs. dense arrangement.

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space in the mix for each instrument. The busier the arrangement the harder it is to lay emphasis on a specific instrument or emphasize fine details.

Both Andy Wallace and Nigel Godrich faced sparse arrangements consisting of a guitar and vocal only in sections of "Polly" by Nirvana and "Exit Music" by Radiohead. Each tackled it in a different way—Wallace chose a plain, intimate mix, with fairly dry vocal and a subtle stereo enhancement for the guitar. Godrich chose to use very dominant reverbs on both the guitar and vocal. It is interesting to note that Wallace chose the latter, reverberant approach on his inspiring mix for "Hallelujah" by Jeff Buckley—an almost seven-minute song with an electric guitar and a single vocal track.

It is not uncommon for the final multitrack to include extra instrumentation along with takes that were recorded as try-outs, or in order to give some choices during mixdown. It is possible, for example, for the multitrack to include eight power-guitar overdubs; sometimes only mixing two of these tracks serves the mix best. Ditto for five different microphones that capture a kick drum.

There are opposite situations where the arrangement is so minimalist that it is very hard to produce a rich, dynamic mix. In such cases, nothing should stop the mixing engineer from adding instruments to the mix—so long time, talent, and ability allow this, and the client approves the additions.

It is OK to remove or add to the arrangement during mixdown.

It is worth remembering that the core process of mixing involves both **alteration** and **addition** of sounds—a reverb, for example, is an additional sound that occupies space in the frequency, stereo, and time domains. Some producers take this well into account by "leaving a place for the mix"—the famous vocal echo on Pink Floyd's "Us and Them" is a good example of this.

The recordings

Mixing in the production chain

Figure 4.2 illustrates the common production chain for recorded music. Producers may give input at each stage, but they often focus on the arrangement and recording stages. Each stage has an impact on the subsequent stage, yet it might be carried out by different people.

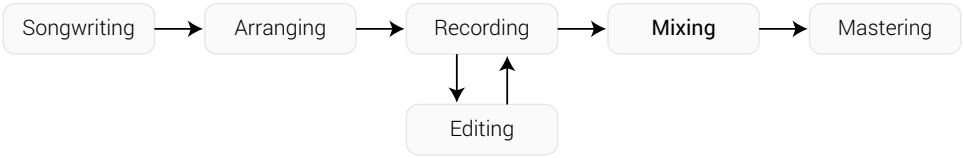

Figure 4.2 Common production chain for recorded music.

Mixing is largely dependent on both the arrangement and recording stages. A wrongly placed microphone can result in an acoustic guitar lacking body, which could be hard to rectify during mixdown. Some recording decisions are undoubtably mixing decisions. For example, the choice of stereo-miking technique for drum overheads determines the localization and depth of the various drums in the final mix. Altering these aspects during mixdown takes effort.

Mixing engineers, when a separate entity in the production chain, commonly face arrangement or recording issues such as those mentioned above. There is such a strong link between the arrangement, recordings, and mix that it is dubious for a producer or a recording engineer to have no mixing experience whatsoever. A good producer anticipates the mix. There is an advantage to having a single person helping with the arrangement, observing the recording process, and mixing the production. This ensures that the mix is borne in mind throughout the production process.

Recording the whole versus recording its parts

The production process has generally become more segregated through the years. In the early days of the recording industry, orchestras were placed in front of a single microphone and recorded into a monophonic medium. There was no mixing other than "physical mixing"—placing musicians in space to get the balance right. The practice of having all the musicians playing together continued even when multitracks appeared, and for high-budget projects this still happens today.

As technology evolved, more and more mixing was taking place—first to tape, then from tape—and the option to defer sonic decisions to a later stage became progressively attractive and economical. Singers would be placed in vocal booths, while instruments would be close-miked. To gain even further sonic control, musicians would stop playing together and instead take turns in the studio. In today's budget and home studios, this is pretty much the standard.

The paradigm used during the recording stage affects mixing a great deal. In the past and in many modern-day high-budget projects, the sonic aspects of the musical piece are shaped in the recording studio and great attention was given to the whole (how instruments sound together, which will in turn inform microphone placement and processing). This would normally leave the mixing engineer with the job of "spicing up" a production that is already fairly mixed.

In contrast, there is normally more sweat involved when musicians play in turns and neither the recording nor the listening environments are great—as in most bedroom studios—since the focus natively shifts from the whole to its parts. This summons the risk that while recording, each instrument is captured so it sounds as good as it can in isolation; but during mixdown, the individual instruments may not combine well. For example, the kick and bass might sound epic when each is played in isolation but combined they would mask one another. Thinning the bass might work better in mix context. Mixing often involves altering recordings to fit into the mix—no matter how well instruments sound in isolation.

Mixing the whole versus mixing its parts

The whole versus part topic is equally important during mixdown. Do individual elements constitute the mix, or does the mix consist of individual elements? Those who believe in the former might give more attention to how the individual elements sound, but those who subscribe to the latter care about how the sound of individual elements contributes to the overall mix. It is worth remembering that the mix—as a whole—is the final product. This is not to say that the sound of individual elements is not important, but the overall mix takes priority.

In the world of mixing, it is common for instruments to "take one for the team."

A few examples would be appropriate here. It is rather routine to apply a high-pass filter to vocals in order to remove muddiness and increase its definition. This type of treatment can make the vocals sound utterly unnatural when soloed. However, this unnatural sound often works extremely well in mix context. As another example, vocals can be compressed while soloed, but the compression can only be perfected when the rest of the mix is playing as well—level variations might become more noticeable with the mix as a reference. Overheads compression should also be evaluated against the general dynamics and intensity of the mix.

The question even goes into the realm of psychoacoustics—our brain can separate one sound from a group of sounds. So, for example, while equalizing a kick, we can isolate it from the rest of the mix in our head. However, we can just as well listen to the whole mix while equalizing a kick, and by doing so improve the likelihood of the kick sounding better in mix context. This might seem a bit abstract and unnatural—while we manipulate something, we seek to clearly hear the effect. The temptation to focus on the manipulated element always exists, but there is a benefit in listening to how the manipulation affects the mix as a whole.

It can be beneficial to employ a mix-perspective rather than an instrument-perspective, even when treating individual instruments.

Home recordings

Opposite audio folklore stands mounting evidence that affordable equipment can deliver great results. Skill and experience are worth more than a U87. Equally, a couple of quality closed-back headphones could mitigate the need to convert the garret into a control room, let alone costing much less.

The real problem of home studios is their acoustics.

Isolation is one problem. It was extremely challenging to record any vocals during rush hour when I lived a stone's throw away from the London Overground lines. London has unique buildings and unique building materials. Some walls are made of a physics-defying material that transmits more sound than Nori. Recording becomes spectacularly problematic when on the other side of your wall is the bedroom of a young couple with a newborn. But where there's a will there's a way.

A usually bigger problem for home recordings is reverb, part of the "room sound." A typical domestic room would involve a fair amount of reverb, but more often than not, not the sort we want to capture. Acoustic treatment is never a bad thing, and it doesn't have to be professional-grade—anything that absorbs sound will reduce the amount of reverb. This includes carpets, canvases on the wall, or towels covering wardrobe doors. Microphones can also be fenced using dedicated isolation shields or even a duvet. But proper acoustic treatment can be expensive, hard to fit, and there are always diminishing returns the lower the frequencies.

Yet, generally speaking, a problematic room limits our microphone choices to those that capture less room, like most dynamic microphones. If the plot succeeds and very little ambiance is captured, this ambiance often has to be re-created during mixdown using reverbs. The good news is that even when an expensive studio is at their disposal, some producers employ a wet/dry recording approach, where many instruments are recorded with some microphones capturing the room reverb (wet) while others capturing as little of it as possible (dry). This gives more control and options during mixdown. The bad news is that for drum kits at home, it is nearly always a case of you are either unlucky or unlucky.

Another aspect of the "room sound" has to do with domestic rooms being typically small and boxy. This means that microphone placement can greatly influence the frequency content of the recordings, with the lows and low-mids being most affected (this has to do with room modes, which are discussed in chapter 8). Microphone placement, in this context, does not mean where the microphone is relative to the instrument, but rather where the microphone is in the room. It might pay to experiment with various microphone locations, with the middle of each dimension being the most likely location to avoid.

Garbage in; garbage out?

The quality of the recorded material has an enormous influence on the mix. A famous saying is "garbage in; garbage out." Flawed recordings can be rectified to a certain extent during mixing, but there are limitations. Good recordings leave the final mix quality to the talent of the mixing engineer and allow for greater creative opportunities.

Nevertheless, experienced mixing engineers can testify to how drastically the process of mixing can improve poor recordings, and how even low-budget recordings can be turned into an impressive mix. Much of this is thanks to the time, talent, and passion of the mixing engineer, and sometimes involves a few mixing "cheats," such as the triggering of drum samples and re-amping of guitars.

Garbage in; garbage out. Still, a lot can be improved during mixdown.

Life has it that sometimes the quality of the raw tracks is poor to an extent that makes them impossible to work with. For instance, distorted guitar recordings that involve such a degree of comb filtering, that it makes more sense to re-record them than to fix the recording. But then, what you can't fix you can hide, trash, or break even more. For example, if an electric guitar was recorded with a horrible pedal monophonic reverb that just does not fit into the mix, maybe over-equalizing it and ducking it with relation to a delayed version of the drums will yield such an unusual effect that nobody will

notice the mono reverb anymore. Clearly there is a limit to how many instruments can receive such dramatic treatment so sometimes re-recording is inevitable.

In other cases, it is the arrangement that is to blame, as when the recorded tracks involve a limited frequency content or the absence of a rhythmical backbone. Again, there is nothing to stop the mixing engineer from adding new sounds, or even re-recording instruments; nothing, apart from time availability and ability.

What you can't fix you can hide, trash, or break even more.

Editing

Generally, on projects that are not purely sequenced, editing is the final stage before mixing. Editing is subdivided into two types:

- **Selective**—primarily concerned with choosing the right takes, and the practice of *comping*—combining multiple takes into a composite master take.
- **Corrective**—done to repair a bad performance.

Anyone who has ever engineered or produced in a studio knows that session and professional musicians are a true asset. But as technology is moving forward, enabling more sophisticated performance corrections, mediocre performance is becoming more acceptable—why should we spend money on vocal tuition and studio time when a plugin can make the singer sound in tune? Drum correction is also a common practice. On big projects, a dedicated editor might work with the producer to do this job. Unfortunately, though, sometimes it is the mixing engineer who needs to do such a job.

A lot of corrective editing can be done mechanically. Most drums can be quantized to metronomic precision, and vocals can be made perfectly in tune. Although many pop albums feature such extreme edits, many advocate a more humanized approach that calls for little more than an acceptable performance (perhaps ironically, sequenced music is often humanized to give it feel and swing). Some argue that over-correcting is against genuine musical values. It is also worth remembering that corrective editing typically involves some quality penalty. In addition, audio engineers are much more sensitive to subtle details than most listeners. To give an example, the chorus vocals on Beyoncé's "Crazy in Love" are late and offbeat, but many listeners don't notice it.

Sequenced music

The production process of sequenced music (Figure 4.3) is very different in nature to that of recorded music. In a way, it is a mixture of songwriting, arranging, and mixing—producing for short. This affects mixing in two principal ways. First, today's DAWs, on which most sequenced music is produced, make it easy to mix as you go. The mix is an integral part of the project file, unlike a console mix that is stored separately from the multitrack. Second, producers commonly select samples or new sounds while the mix is playing along; unconsciously, they choose sounds based on how well they fit into the existing mix. A specific bass preset might be dismissed if it lacks definition in the mix, and a lead synth might be chosen based on the reverb that it

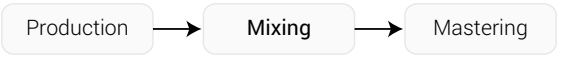

Figure 4.3 Common production chain for sequenced music.

brings with it. Some harmonies and melodies might be transposed so they blend better into the mix. The overall outcome of this is that sequenced music arrives at the mixing stage partly mixed.

As natural as this practice may seem, it is not without its issues. To begin with, synthesizer manufacturers and sample-library publishers often add reverb (or delay) to presets in order to make them sound bigger. These reverbs could be permanently imprinted onto the multitrack submission and have restricted depth, stereo images, and frequency spectrums that might not integrate well with the mix. Generally speaking, dry synthesized sounds and mono samples offer more possibilities during mixdown. In addition, producers sometimes get attached to a specific mixing treatment they have applied, such as the limiting of a snare drum, and print these to the submitted multitrack. Very often, the processing is done using inferior plugins, in a relatively short time, and with very little attention to how the processing affects the overall mix. Flat dynamics due to over-compression or ear-piercing highs are just two issues that might have to be rectified during a separate mixing stage.

Sequenced music often arrives at the mixing stage partly mixed—which could be more of a hindrance and less of a help.

Where to start

Preparations

Projects submitted to mixing engineers are usually accompanied by documentation—session notes, track sheets, edit notes, etc.—these are worth inspecting. Clients might have ideas, guidelines, or requirements regarding the mix, which are often discussed at this stage. In addition, there are various technical tasks that might need to be accomplished; these will be discussed shortly.

Auditioning and the rough mix

Unless we were involved in earlier production stages and are fluent with the raw tracks, we must listen to what is about to be mixed. Auditioning the raw tracks allows us to learn the musical piece; capture its mood and emotional features; and identify important elements, moments, or problems we will need to rectify. We study our ingredients before we start cooking.

Often, a rough mix (or a monitor mix) is provided with the raw tracks. It can teach much about the song and inspire a particular mixing direction. Even when a rough mix is submitted, creating our own can be extremely useful—in doing so, we familiarize ourselves with the arrangement, structure, quality of recording, and, maybe most importantly, how the musical qualities can be conveyed. Our own rough mix is a

noncommittal chance to learn much of what we are dealing with, what has to be done, and how; it can help us to start formulating a mixing plan or vision.

Rough mixes, especially our own, are beneficial.

One issue to be aware of is that it is not unheard of for the artist and/or mixing engineer to unwittingly become so accustomed with the rough mix that they use it as an archetype for the final mix. This unconscious adoption of the rough mix is only natural since it often provides the first opportunity to hear how different elements transform and begin to sound like the real thing. However, this could be dangerous territory since rough mixes, by nature, are just that—rough. They are done with little attention to small details, and sometimes involve random try-outs that make little technical or artistic sense. Yet, once accustomed to them, we find it hard without them—a point worth remembering.

Sometimes the rough mix is a throwaway; other times it serves as a skeleton for the actual mix. Such a workflow is similar to the two distinct stages employed by many artists when drawing. First, a pencil is used to quickly sketch the artwork outline, with any inaccuracies quickly corrected by "drawing over" with a bolder shade. Once satisfied, the artist then moves into a much slower phase concerned with precision and detail. This method provides some guidance as to how we may want to approach rough mixes—a quick, carefree go at getting the foundations in place. Under strict time-constraints, people tend to focus on the most valuable things, and noncommittal settings liberate us from various phycological gremlins that can get in creativity's way. Such an approach to rough-mixing is well worth trying out, as it can improve both our skills and the mix in question.

The plan

Just bringing faders up and doing whatever seems right is arguably not very effective—a bit like playing a football match without tactics. Every mix is different, and different pieces of music require different approaches. Once we are familiar with the raw material, a plan of action is developed, either in the mind or on paper. Such a plan can help, even when the mixing engineer recorded or produced the musical pieces—it resets the mind from any sonic prejudgments and creates a fresh start to the mixing process. Below is an example of the beginning of a rough plan before mixing commences. As you can see, this plan includes various ideas, from panning positions to the actual equipment to be used; there are virtually no limits to what such a plan might include:

> I am going to start by mixing the drumbeat at the climax section. In this production the kick should be loud and in-your-face; I'll be compressing it using the Distressor, accenting its attack, then adding some sub-bass. The pads will be panned roughly halfway to the extremes and should sit behind everything else. I should also try and distort the lead to tuck in some aggression. I would like it to sound roughly like "Stronger" by Kanye.

It might be hard to get the feel of the mix in the very early stages. Understandably, it is impossible to write a plan that includes each and every task. Moreover, such a detailed plan can limit creativity and chance. Therefore, instead of one big plan, it can be easier to work using *small plans*—whenever a small plan is finished, a new evaluation of the

mix takes place and a new plan is established. Here is a real-life example of a partial task list from a late mixing stage:

- Kick sounds flat
- Snare too far during the chorus—replace with triggers (chorus only)
- Stereo imbalance for the strings—amend panning
- Solo section: violin reverb is not impressive enough
- Haas guitar still not defined
- Automate snare reverbs

Not every mixing engineer approaches mixing with a detailed plan; some do it spontaneously and in their heads. Yet, there is always some methodology, or some procedure being followed.

Mixing is rarely a case of "whatever seems right next."
Have a plan, and make sure you identify what's important.

Technical vs. creative

The mixing process involves both technical and creative tasks. Technical tasks are generally those that do not actually affect sounds, or those that relate to technical problems with the raw material. They usually require little sonic expertise. Here are a few examples:

- **Neutralizing (resetting) the desk**—analog desks should be neutralized at the end of each session, but this is not always the case. Line gains and aux sends are the usual suspects that can later cause trouble. Line gains can lead to an unbalanced stereo image or unwanted distortion. Aux sends can result in unwanted signals being sent to effects units.
- **Housekeeping**—projects might require some additional care, sometimes simply for our own convenience. For example, file renaming, removing unused files, consolidating edits, etc.
- **Track layout**—organizing the appearance order of the tracks so they are convenient to work with. For example, putting all the background vocals or drum tracks next to each other, or having the sub-oscillator next to the kick. Sometimes the tracks are organized in the order in which they will be mixed; sometimes the most important tracks are placed in the center of a large console. Different mixing engineers have different layout preferences to which they usually adhere. This enables faster navigation around the mixer, and increased accessibility.
- **Phase check**—recorded material can suffer from various phase issues (these are described in detail in Chapter 12). Phase problems can have subtle to profound effects on sounds, and it is therefore important to deal with them at the beginning of the mixing process.
- **Control/audio grouping**—setting any logical group of instruments as control or audio groups. Common groups are drums, guitars, vocals, etc.
- **Editing**—any editing or performance correction that might be required.
- **Cleaning up**—many recordings require the cleaning up of unwanted sounds, such as the buzz from guitar amplifiers. Cleaning up can also include the removal of extraneous sounds such as count-ins, musicians' talk, coughs, etc. These unwanted

sounds are often filtered either by gating, a strip-silence process, or region trimming. (Some of these tasks might be performed at the end of the mixing stage.)
- **Restoration**—unfortunately, raw tracks can incorporate noise, hiss, buzz, or clicks. These are more common in low-budget recordings, but can also appear due to degradation issues. It is important to note that clicks might be visible but not audible (inaudible clicks can become audible if being processed by devices such as enhancers or if being played through different D/A converters). Some restoration treatment, de-noising for example, might be applied to solve these problems.

Creative tasks are essentially those that allow us to craft the mix. These might include:

- Using a gate to shape the timbre of a floor tom.
- Tweaking a reverb preset to sweeten a saxophone.
- Equalizing vocals in order to give them more presence.

While mixing, we have a **flow of thoughts and actions**. The **creative process** could do without distractions. Any technical task can break the creative flow. If, while equalizing a double bass, you find that it is offbeat on the third chorus, you might be tempted to context-switch and fix the performance straight away (after all, a bad performance can be really disturbing). By the time the editing is done, you might have switched off from the equalizing process or the creative process altogether. It can take some time to get back into the creative zone. It is therefore beneficial to go through all the technical tasks first, which clears the path for a distraction-free creative process.

At any rate, it pays to develop the discipline to defer technical tasks whilst "in the zone."

Technical tasks can interrupt the creative flow.
Better complete them first (or last).

Which instrument?

Different engineers have a different order in which they mix the different tracks. There are lots of differences in this business. Some engineers are not committed to one order or another—each production might be mixed in the order they see as most suitable. Here is a summary of some common approaches, and their possible advantages and disadvantages:

- **The serial approach**—starting with very few tracks, we listen to them in isolation and mix them first, then gradually more and more tracks are added and mixed. This divide-and-conquer approach enables us to focus well on individual elements (or stems). The danger is that as more tracks are introduced, there is less space in the mix.
- **Rhythm, harmony, melody**—we start by mixing the rhythm tracks in isolation (drums, beat, and bass), then other harmonic instruments (rhythm guitars, pads, and keyboards), and finally the melodic tracks (vocals and solo instruments). This method often follows what might have been the overdubbing order. It can feel a bit odd to work on drums and vocals without any harmonic backing. But arguably, from a mixing point of view, it makes little sense mixing in an organ before the lead vocal.
- **In order of importance**—tracks are brought up and mixed in order of importance. So, for instance, a hip-hop mix might start with the beat, then lead vocals, then

additional vocals, and then all the other tracks. The advantage here is that important tracks are mixed at early stages when there is still space in the mix and so they can be made bigger. The least important tracks are mixed last into a crowded mix, but there is less of a consequence in making them smaller.
- **Parallel approach**—this involves bringing all the faders up (of key tracks), setting a rough level balance, rough panning, and then mixing individual instruments in whatever order one desires. The advantage with such an approach is that nothing is being mixed in isolation. It can work well with small arrangements but can be problematic if many tracks are involved—it can be very hard to focus on individual elements or even make sense of the overall mix at its initial stages. As an analogy, it would be like playing football with eight balls on the pitch.

There are endless variations to each of these approaches. Some, for example, start by mixing the drums (the rhythmical spine), then progress to the vocals (most important), and then craft the rest of the mix around these two important elements. Another approach, which is more likely to be taken with more spatial mixes, involves mixing the front instruments first, and then adding the instruments panned to the back of the mix.

There are also different approaches to **drum mixing**. Here are a few things to consider:

- **Overheads**—the overheads are a form of reference for all the other drums. For example, the panning position of the snare might be dictated by its position on the overheads. Changes made to the overheads might affect other drums, so there is some advantage in mixing them first. Nonetheless, many engineers prefer to start from the kick, then progress to the snare, and only then perhaps mix the overheads. Sometimes the overheads are the last drum track to be mixed. Another factor here is how loud the overheads will end up being—in some mixes there is not much of them, so they are less of a concern for other drums.
- **Kick**—being the most predominant rhythm element in most productions, the kick is often mixed before any other individual drum and sometimes even before the overheads. Following the kick, the bass might be mixed and only then other drums.
- **Snare**—as the second most important rhythm element in most productions, the snare is often mixed after the kick.
- **Toms**—as they are typically only played occasionally, they are often the least important contributors to the overall sound of the drums (and yet their effect in the mix can be vital). Some leave the toms to be mixed at a very late stage.
- **Cymbals**—the hi-hats, ride, crashes, or any other cymbals might have a sufficient presence on the overheads. Often in such cases, the cymbals are used to support the overheads, or only mixed at specific sections of the song for interest's sake. Sometimes these tracks are not mixed at all.

Which section?

With rare exceptions, the process of mixing involves working *separately on the various sections*. Each section is likely to involve different mixing challenges and a slightly different arrangement (choruses are commonly denser than verses). And so, mixing engineers usually loop one section, mix it, then move on to the next section and mix it based on the existing mix. The question is: Which section should be first? There are two approaches here:

- **Chronologically**—starting from the top and slowly advancing to succeeding sections (intro, verse, chorus). It seems logical to work this way since this is the order in which music is played and recorded. However, while we might mix the verse perfectly—creating a rich and balanced mix—there will be very little place in the mix for new instruments introduced during the paramount chorus.
- **In order of importance**—the most important section of the song is mixed first, followed by the less important sections. For a recorded production, this section is usually the chorus; for some electronic productions, it will be the climax. Very often, the most important sections are also the busiest ones; therefore, mixing them first can be beneficial.

Which treatment?

A common guideline for treatment order is shown in Figure 4.4. With the exception of faders (which need to be up for sound to be heard), there is no reason to adhere to this. Later in the book, we will encounter a few techniques that involve a different order. However, there is some logic in this worth covering.

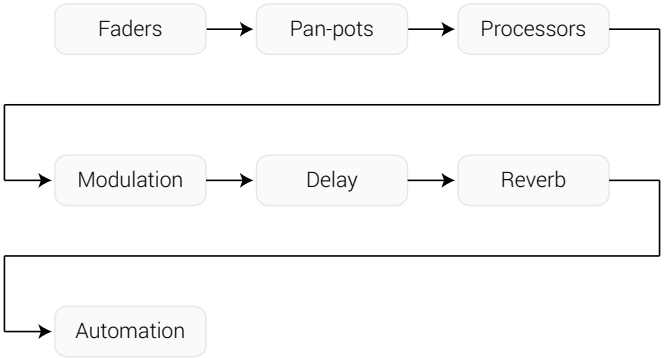

Figure 4.4 The "standard" treatment order guideline.

If we skip panning and mix in mono, we lose both the width and depth dimensions. Yet, since masking is more pronounced in mono, sometimes engineers choose to resolve masking by equalizing while listening in mono. This might be done before panning, but more frequently done using mono summing. Since processing replaces the original sound, it comes before any effects that add to the sound (modulation, delay, or reverb). The assumption is that we would like to have the processed signal sent to the effects, rather than what might be a problematic unprocessed signal. Similarly, it is usually desirable to have a modulated sound delayed, rather than having the delays modulated. Finally, since reverb is generally a natural effect, we normally like to have it untreated. In some cases, automation is the last major stage in a mix.

There is also the **dry-wet approach**, in which all the tracks are first mixed using a dry treatment only (faders, pan-pots, and processors), and only then a wet treatment is applied (modulation, delay, and reverb). This way, the existing sounds are all dealt with before adding new sounds to the mix. It also leaves any depth or time manipulations (reverbs and delays) for a later stage, which can simplify the mixing process for some. However, some claim that it is very hard to get the real feel and the direction of the mix without depth or ambiance.

The iterative approach

Back in the days of two-, four-, and eight-track tape recorders, mixing was an integral part of the recording process. For example, engineers used to record drums onto six tracks, then mix and bounce them to two tracks and use the previous six tracks for additional overdubs. The only thing that limited the number of tracks to be recorded was the accumulative noise added in each bounce. Back then, engineers had to commit their mix, time and again, throughout the recording process—once bouncing took place and new material overwrote the previous tracks, there was no way to revert to the original drum tracks. Such a process required enormous forward planning from the production team—they had to mix while considering something that hadn't been recorded yet. Diligence, imagination, and experience were key.

Today's technology offers hundreds of tracks. Even when submix bouncing is needed (due to channel shortage on a desk or processing shortage on a DAW), the original tracks can be reloaded at later times and a new submix can be created. This means that practically everything can be altered at any stage of the mixing process, and nothing has to be committed before the final mix is printed.

Flexibility to undo mixing decisions at any point in the mixing process is a great asset since **mixing is a correlative process**. The existing mix should normally be retouched to accommodate newly introduced tracks. For example, no matter how good the drums sound when mixed in isolation, the introduction of distorted guitars into the mix might require additional drum treatment (the kick might lose its attack, the cymbals might lose definition, and so forth). Plus, treatment in one area might require subsequent treatment elsewhere. For instance, when brightening the vocal by boosting the highs, high frequencies may linger on the reverb tail in an unwanted way, so the damping control on the reverb might need to be adjusted. The equalization might also make the vocal seem louder in the mix and so the fader might need to be adjusted. If the vocal is first equalized and then compressed, the compression settings might need to be altered as well.

Since mixing is such a correlative process, it can benefit from an **iterative coarse-to-fine approach** (Figure 4.5). This means starting with a coarse treatment on which we spend less time, then, as the mix progresses continually, refining previous mixing decisions. Most of the attention is given to the late mixing stages, where the subtlest changes are made. There is little justification in trying to get everything right before these late stages—what sounds fine at one point might not be so later.

Start with coarse and finish with fine.

Milestones

The mixing process can have many milestones. On the macro level, there are a few that are potentially key (Figure 4.6). The first involves bringing the mix into an adequate state. Once this milestone is reached, the mix is expected to be free of any issues—whether they existed on the raw tracks or were introduced during the actual process of mixing. Such problems can range from basic issues such as relative levels (e.g., solo guitar too quiet) to more advanced concepts such as untidy ambiance.

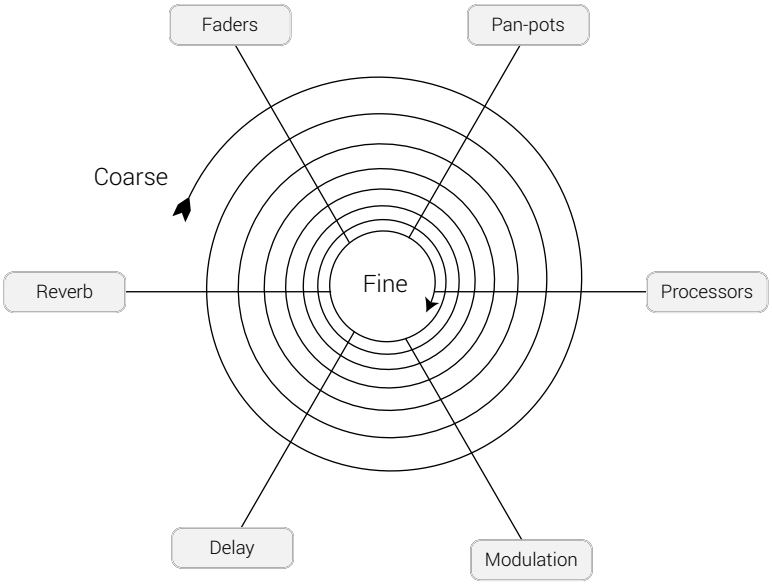

Figure 4.5 The iterative coarse-to-fine mixing approach.

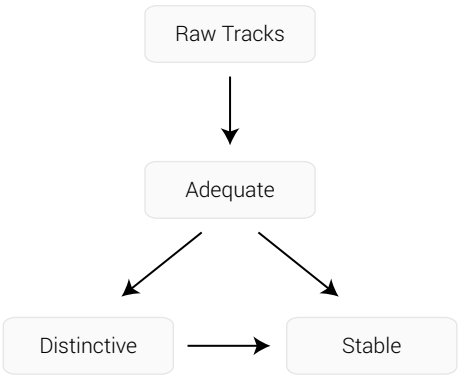

Figure 4.6 Possible milestones in the mixing process.

Nevertheless, a problem-free mix is not necessarily a good one. The next milestone often involves making the mix distinctive or appealing. The definition of such qualities are abstract and these vary between one mix and another, but the general objective is to make the mix notable—memorable—whether by means of interest, power, feel, or any other sonic property.

The final milestone, which often only applies to the inexperienced engineer, is stabilizing the mix.

Finalizing and stabilizing the mix

All the decisions we make while mixing are based on the evaluation of what we hear at the listening position; otherwise known as the *sweet spot*. But mixes can sound radically different once one leaves this sweet spot. Here are some prime examples:

- Different **speakers** reproduce mixes differently—each speaker model (sometimes in combination with its amplifier) has its own frequency response, which also affects perceived loudness. While listening on a different set of speakers, the vocals might not sound as loud and the hi-hats might sound harsh. Different monitor positions also affect the overall sound of the mix, mainly with relation to aspects such as stereo image and depth.
- Mixes sound different in different **rooms**—each room has its own sonic stamp that affects the music played within it. Frequency response, which is affected by both room modes and comb filtering, is the most notable factor, but the room response (reverb) also plays a part.
- Mixes sound different in different **points in a room**—both room modes and comb filtering alter our frequency perception as we move around the room. A mix will sound different when we stand next to the wall and when we are in the middle of the room. (This issue is discussed in greater detail in Chapter 8.)
- Mixes sound different at different **playback levels**—as per our discussion on equal-loudness curves.

Many people are familiar with the situation where their mix sounds great in their home studio but translates badly when played in their car. It would be impossible to have a mix sounding the same in different listening environments for the reasons explained above. This is worth repeating: mixes *do* sound very different in different places. What we can do is ensure that our mixes are problem-free in other listening environments. This is much the idea behind stabilizing the mix.

The reason that it is usually the novice that has to go through this practice is that the veteran mixing engineer knows her mixing environment so well that she can predict how well the mix will sound in other places. Also, in comparison to a professional studio, the sweet spot in a home studio is actually quite sour. Acoustic problems in home studios can be profound, while in a professional studio these are rectified by expensive construction and acoustic design, carried out by experts.

The process of stabilizing the mix involves listening to the mix in different locations, different points within those locations, and at varying levels. Based on what we hear, we can finalize the mix by fine-tuning some of its aspects. Normally, this involves subtle level and equalization adjustments. Here is how and where mixes should be listened to during the stabilizing phase:

- **Quiet levels**—the quieter the level, the less prominent the room and any deficiencies it exhibits. Listening quietly also alters the perceived loudness of the lows and highs, and it is always a good sign if the relative level balance in the mix hardly changes as the mix is played at different levels. Listening at loud levels is also an option, but can be misleading as mixes usually sound better when played louder.
- **At the room opening**—also known as "outside the door." Many find this listening position highly useful. When listening at its opening, the room becomes the sound

source, and instead of listening to highly directional sound coming from the (relatively) small speakers we listen to reflections that come from many points in the room. This reduces many acoustic problems caused by the room itself. The monophonic nature of this position can also be an advantage.

- **Car stereo**—a car is a small, relatively dry listening environment and many find it useful to audit their mixes there. In the same way as the room-opening position, a car provides a very different acoustic environment that can reveal problems.
- **Headphones**—with more and more people listening to music on mobile devices via headphone, comes the growing need to check mixes using headphones. With the use of headphones, we will sacrifice some aspects of stereo image and depth but not have to worry about room modes, acoustic comb filtering, and left/right phase issues. We can regard listening via headphones as listening to the two channels in isolation, and it is known that headphones can reveal noises, clicks, or other types of problems that may not be as noticeable via speakers. The main issue with headphones is that you need a good pair, and that the stereo panorama changes quite drastically compared to a playback via speaker (having said that, nowadays listeners are more likely to listen to the mix on headphones than on a pair of well-positioned speakers).
- **Specific points in the room**—many home studios present poor acoustics, and very often there are issues at the sweet spot. Moving out of this spot can result in an extended bass response and many other level or frequency revelations. Also, the level balance of the mix changes as we move off-axis and out of the monitors' close range. Beyond a certain point (the critical distance), the room's combined reflections become louder than the direct sound—most end listeners will listen to mixes under such conditions, so it is important to hear what happens away from the sweet spot.

Evaluating the mix using any of these methods can be misleading if caution is not exercised. While listening in a specific point in a room, it might seem that the bass disappears and subsequently we might be tempted to boost it in the mix. But there is a chance that it is that point in the room causing the bass deficiency, while the mix itself is fine. How, then, can we trust what we hear in any of these places? The answer is that we should focus on specific places and learn the characteristics of each. Usually, rather than going to random points, people evaluate mixes in the exact same point of the room every time. In addition, playing a familiar reference track to see how it sounds in each of these places is a great way to learn the sonic nature of each location.

While listening to the mix in different places, it could be wise to **make a note of** what issues you notice and which require further attention, then go back to the mixing board. In some cases, comments cancel one another out. For example, if while using headphones it seems that the cymbals are too harsh but when listening at the room opening they sound dull, perhaps nothing should be adjusted.

As a final piece of advice, listening in different locations is not reserved for final mix stabilization—it can also be beneficial at other stages of the mixing process, especially when decisions seem hard to make.

Mix edits

Very often, especially in the commercial industry, more than one version of a mix is required; these versions are referred to as "edits." Primarily, this practice is concerned

with creating a mix that will conform to the destination playback system. Some of these edits can be produced during the mastering stages. But mixing engineers have more control over individual tracks and, hence, the final result. Common edit candidates are:

- **Album version**—the mix to be included on the album.
- **Radio edit**—various factors should be considered for a mix that is intended for broadcast on the radio. First, since mixes played on the radio are heavily compressed and limited before transmission, mixing engineers sometimes check their mixes through heavy compression or limiting to see how the mix will translate under such conditions. Second, since it is fair to assume that radio listeners are likely to listen in noisy environments, vocals are commonly pushed up in radio edits. Third, longer songs are less likely to be played on commercial radio and therefore long album versions are commonly shortened using edits and fades. Fourth, since most radio systems have limited ability to reproduce low frequencies, very often these are filtered or attenuated to some extent. Finally, some lyrical content might require censorship, which is usually done by mutes or 1 kHz tone.
- **Club and LP versions**—it is assumed that both of these will be pressed on a vinyl, which requires centered bass content, and minimum phase differences between the left and right channels, especially at low frequencies. As opposed to radio, club sound systems are expected to provide an extended low-frequency response, so mixing engineers must use full-range monitors to make sure that the low end is properly mixed. Most clubs have a limiter on the signal chain as well.
- **Vocals-up/vocals-down**—the levels of the vocals in mixes are critical. Very often, two mixes are bounced, with the vocals varying by around 1–2 dB between the two. The A&R, producer, and artist usually pick their favorite version. If appropriate, it is also possible to record additional variations, such as drums-up/drums-down.

As well as these common edits, additional edits or stems might be required; for example, an instrumental mix, a cappella mix, video mix, TV (instrumental and backing vocals), no solo, and so on.

Mastering

Why master?

Why do we need mastering engineers? Primarily because anyone about to release a track to the public would like the last person to work on that track be a highly skilled and experienced engineer that works in a studio with optimal acoustics. Mastering is partly about ensuring quality and increasing quality and we need a specialized person in a specialized studio to do that.

Mastering engineers have more roles than meet the eye. When assembling an album, they remove extraneous sounds, arrange the tracks in the most compelling order, apply smooth fades and natural pauses, and balance both the frequency spectrum and the level of the various tracks so the album sounds like a coherent piece rather than a collection of unrelated songs.

Once a master is completed and approved by the client, they produce a high-quality copy that is fit for digital streaming, and, in some cases, one that complies with the requirements of manufacturing plants.

Perhaps their most important role is to bring the sonic aspects of an album to their best and most appealing state. If the mixes are good, mastering engineers can make polished diamonds out of gold.

The equipment used in a professional mastering studio usually cost more than its equivalent in mixing facilities, and the listening environment is optimized to rectify possible problems, mostly acoustic. It is common, for example, to find mastering studios with nothing that could cause comb filtering (including a desk) between the full-range monitors and the listening position. Theoretically, mastering engineers might have to amend the mixes very little if the mixing engineer did the job right. But rarely do mixing engineers have the environment or tools to achieve the critical quality that mastering engineers can.

It should be clear why mastering is so significant—once the finished master leaves the mastering studio, any problems will be heard by many and will potentially damage commercial success, sales, and—most importantly—the joy of listening.

Simply put, mastering is an art and science reserved for the experts.

Some mixing engineers submit mixes that have some mastering-like treatment, mostly compression. In subtle amounts, and if done correctly, it can improve the overall sound of the mix. But common sense has it that whatever a mixing engineer can do on the stereo mix a mastering engineer can do better. Why would you try to fix your company car if your company will pay a professional mechanic to do it for you?

Mastering delivery

Historically, mixes used to be submitted for mastering on ½" analog tapes. Later, DATs became popular, then CD-ROMs, DVD-ROMs, external hard drives, USB sticks, and nowadays many just upload files to the cloud. Although uncommon today, CD-DAs (audio CDs) are prone to errors more than other types of media, and should not be used. The actual submission is often accompanied by some documentation (track names, etc.).

When working on a stereo mix, one of the greatest challenges in mastering is that each instance of processing affects all the elements of the song. For instance, correcting sibilant vocals can reduce the snare's clarity when sibilance occurs. The high-fidelity tools at the mastering engineer's disposal can fix many issues, but the more the mix needs correction, the more quality is compromised. Since nowadays it is possible to find multitrack applications in a mastering studio, it is not uncommon to submit mixes in *stems* (submixes of logical track groups, or even just a single track). If there are any problems in the mix, the mastering engineer might find it easier to process the individual stems rather than the mix as a whole. Common stems are vocals, rhythm, leads, and the residue mix (which consists of everything but what is already included in other stems). In all cases, a full stereo mix should be submitted as well, and should be identical to the mix of all the other stems when their faders are at unity gain (0 dB).

Sometimes the client or mastering engineer asks for changes to mixes after these have been completed. In a large studio with an analog console, recalling mixes can be time-consuming. Saving a mix in stems can be beneficial in such situations—instead of recalling the whole mix (console and outboard gear), we can only recall the mix of the stem that requires alterations, while playing all the other stems untouched.

There are a few additional practices worth considering when submitting mixes to mastering:

- **Do not fade**—leave any fades at the beginning or end of each track for the mastering engineer. He or she can do more-musical fades once the order of the tracks has been determined, and can use any noises at the beginning or end of the track for noise reduction. Make sure that you leave the full reverb tail at the end of the track or any other instrument decay.
- **Use WAV files**—these are supported on both Mac and PC platforms, and aren't compressed.
- **Keep the original digital audio quality**—do not perform any sample-rate or bit-depth conversions. These are likely to degrade the quality of the audio, and have no advantage from a mastering point of view—many mastering engineers will convert the mixes to analog before processing, and will use high-quality converters to capture the analog signal and then convert it back to the appropriate digital format.
- **Disable any master bus processing**—sometimes the master bus in a mixing session has EQs, compressors, limiters, enhancers, or other processors. These can make the mix more appealing during mixing sessions, but most likely better redone during mastering. If terribly attached to these, one can always submit two versions—with and without master bus processing.
- **No clips**—ensure the master bus audio doesn't clip.

The loudness war

Louder is perceived as better. We have already established that. In a world where everyone wants to be better, everyone wants to be louder. And once the meme has spread globally, it eventually got tagged as a "war." It is nothing short of ludicrous that too often the main ask from mastering engineers is to make it "as loud as possible"; and it is equally sad that many online mastering services are judged by the loudness of the masters they return, not by the overall quality of the masters. But where there's a human bias, there will be those to exploit it. The catch is that crazy-loud masters are likely to sound worse to end listeners than anything sensibly loud or even tracks that are not loudness-boosted at all.

Radio stations were one of the first to exploit the commercial prospect of loudness. If you switch from 99FM to 100FM and the latter sounds better, you are less likely to tune out. If you then switch to 101FM and it doesn't sound as good, you are more likely to switch back. Add advertising to the mix and loudness equals money. FM radio stations had limiters installed already because overshooting levels meant a penalty for overshooting the station's allocated frequency range. Making your station louder simply meant pushing the volume against the limiter. But any station could do that, and the more you push the more distortion, and things can turn nasty quick. So radio stations started incorporating ever more sophisticated chains of loudness boosting in order to prevail. Nobody wanted to be left behind, not even classical stations, which explains