TO THE LIMIT

‘Dynamic Range’ & The Loudness War

We all know music is getting louder. But is it less dynamic? Our ground-breaking research proves beyond any doubt that the answer is no — and that popular beliefs about the ‘loudness war’ need a radical rethink.

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In the press and on the Web, the backlash is growing against the ‘loudness war’, the practice of trying to make recordings sound as loud as possible, so they are perceived as ‘rouller’ than rival releases. According to articles like these, unreasonable mastering practices and, more specifically, the abuse of brick wall limiters, has put music in jeopardy. Modern productions lack subtlety, and sacrifice quality for level. Bob Dylan, in a 2006 interview, went as far as stating that “You listen to these modern records, they’re atrocious, they have sound all over them. There’s no definition of nothing, no vocal, no nothing, just like — static.”

But is Dylan’s remark just a replay of the quarrel between the ancients and the moderns? It would not be the first time the old guard despises what the new generation does. True, many sound engineers have joined the cause of “more dynamic” music. But are they speaking out for what is objectively better — or are they simply

148 September 2011 / www.soundonsound.com
voicing their preference for a particular style of sound? The research I present in this article aims to answer this question. We'll find out whether recent music is really louder, and whether it's really less dynamic. We'll also consider the hypothesis that loudness may be a stylistic marker for specific recent music styles, instead of being a bad habit only motivated by despicable commercial reasons. Finally, we'll take a close look at Metallica's notorious 'Death Magnetic', and see why so many people claim it doesn't sound good.

**Is Music Really Louder Today?**

Yes it is, and there is no doubt about that. Let's take a large number of best-selling and/or very well received 'pop' music pieces recorded and produced between 1969 and 2010, normalise them so they peak at 0dB full scale, and measure their RMS value. Then let's sort all the values according to the year of release of the track to which they correspond. The first diagram, left, shows the experiment's outcome, and it is indeed spectacular! The red line shows the RMS median value for each year, and the rectangles give an indication of the distribution: the darker the rectangle, the more pieces showing such a level. There is, without question, a constant growth in average levels between 1982 and 2005, and today's records are roughly 5dB louder than they were in the '70s.

Admittedly, measuring the signal's RMS value only gives information about the 'electrical' or 'physical' content of the audio file, not a measure of loudness as we perceive it. For that, we evaluate the 'integrated loudness', as defined by the EBU 3341 normative recommendation. As seen on the second page, to the left, in the context of our corpus of songs such a measure is highly correlated to the signal's RMS value, and the two graphs are very similar to each other. This second set of results confirms the first one.

Let's repeat the experiment using other criteria. For instance, one criterion commonly used to describe the dynamic behaviour of a piece of recorded music is the 'crest' factor. Put simply, the crest factor is the difference between the RMS level and the peak level over the course of the song. Intuitively, it measures the amplitude of the emerging 'peaks' in the audio stream. It's considered a good marker of the amount of dynamic compression that was applied to the music: more compression generally means a lower crest factor. Some
professionals consider good handling of the crest factor as the cornerstone of successful mastering. Also, still generally speaking, the lower the crest factor, the louder the music.

The third diagram on the first page shows the evolution of a measure that's analogous to the crest factor. Based on the same 4500 tracks, this simplified crest factor is shown falling by 3dB since the beginning of the '80s, reinforcing the suspicion that the increase in loudness we've been witnessing since the '90s was brought by dynamic compression. You'll see that the evolution of the crest factor can be divided into three stages. First, from 1969 to 1980, the crest factor increases, probably due to the improvement of studio gear in terms of signal-to-noise ratio and dynamic transparency. From 1980 to 1990, the crest factor remains relatively stable. Then, from 1990 to 2010 — the era of the loudness war — the crest factor is dramatically reduced.

Finally, another relevant and helpful descriptor is the proportion of samples in a piece of recorded music that are close to 0dBFS once the piece is normalised. A high density of very loud samples suggests that the master recording has been allowed to clip, or that a look-ahead brickwall limiter such as the Waves L Series has been employed. The fourth diagram traces the density of peak samples in the same 4500-track corpus. The first two diagrams show that music has got louder; the third indicates that this evolution is probably due to dynamic compression; and this illustration shows that such compression is probably applied via digital brickwall limiters.

**What Is The Dynamic Range Of A Piece Of Music?**

This is a surprisingly difficult question to answer. Intuitively, we feel that dynamic range ought to measure how 'variable' or 'mobile' the peak level is. Let's try to give this intuition some substance. The first diagram on the previous page compares the evolution of the signal's RMS value for extracts from two songs: 'Fuk' by Plastikman, and 'Smells Like Teen Spirit', by Nirvana. Apparently, the level of 'Smells Like Teen Spirit' is more mobile than that of 'Fuk'. This is no surprise, considering that Plastikman's music is minimalist techno, whereas Nirvana's productions often feature soft verses and loud choruses.

However, the results change radically if we perform the analysis using an analysis window of 100 milliseconds instead of two seconds. Over the long term, Plastikman's music is more stable in terms of RMS levels — but in the short term, as you can see from the second diagram, it appears to feature more variations in level, because of its loud, dry drums. So if we want to establish a measure of 'level mobility', we need to think about what time scale to employ.

There is also the question of how to actually compute this level mobility: how to get a numerical value that could be a measure of 'dynamic range'. Conceivably, we could measure the overall vertical amplitude of the RMS curve corresponding to a music piece for a given time scale,
by summing the amplitude of each vertical movement. Intuitively, it makes perfect sense: looking again at the top diagram on the second page of this article, on which the blue curve looks more mobile than the red one, the overall vertical amplitude of the blue curve is greater than which of the red one. (Mathematically, this would amount to evaluating the sum of the RMS derivative.)

In practice, however, this method proves to be unreliable. Amongst other problems, an isolated peak in an otherwise flat RMS curve would distort the measure, giving a false impression of significant RMS mobility. A better method, similar to the one used by the EBU to evaluate loudness range, consists of dealing with the RMS variability instead of its mobility. Instead of directly evaluating an ‘RMS mobility’, we compute the distribution of RMS values encountered during the analysis. Such a distribution is shown on the third diagram of the group I’ve been referring to. Then we measure the ‘spread’ of the distribution curve using a trick that’s similar to something called the ‘interquartile range method’ in descriptive statistics: the spread of the curve will leave alone the top five percent and the bottom 10 percent values. We can see that for an analysis window of two seconds, ‘Smells Like Teen Spirit’ has a greater RMS spread than ‘Fuk’.

Let’s change the time scale again and measure this RMS ‘spread’ with RMS values every 0.1s. The outcome of the experiment is shown in the fourth diagram, and again the results are reversed: the spread for ‘Fuk’ is greater than it is for ‘Smells Like Teen Spirit’. Suppose that we now repeat the same experiment for a variety of analysis windows. The result is shown on the last diagram of the same group. Interestingly, level variability for ‘Smells Like Teen Spirit’ is always greater, except for windows below 0.18 seconds, where the drum parts in ‘Fuk’ show a decisive influence.

What is shown in the fifth diagram is a very good candidate for a measure of ‘dynamic range’ of a piece of music. Suppose now that instead of dealing with the signal’s RMS, we deal with a measure of perceptual loudness, such as the one mentioned in the ITU recommendation BS 1770: we would now be dealing with ‘loudness range’. This is, in fact, the basis of how the EBU defines ‘loudness range’ in their EBU Tech 3342 document, as explained in the ‘EBU Measure Of Loudness Range’ box.

There remains the question of whether one should use such a term as ‘dynamic range’ at all: there is no official definition for it, and it may be confused with the dynamic range of a recording medium, which is basically the difference between the highest and lowest level it can handle. During the course of this article, therefore, I won’t talk about ‘dynamic range’ in relation to a piece of music. Instead, I will be using ‘RMS variability’, or more generally ‘dynamic variability’. The term ‘dynamic range’ will be reserved for the measure of signal-to-noise ratio of a recording medium. I will use the term ‘loudness variability’ in strict reference to the EBU 3342 document, and the term ‘loudness variability’ in other cases involving loudness instead of RMS.

Has Loudness Range Decreased?

Here’s where things get surprising. We can prove beyond any doubt that the ‘loudness war’ has not decreased the loudness range, as defined in EBU 3342! Nor has it reduced level variability or loudness variability in any way. Music from
the last decade seems to exhibit as much
dynamic variability as music from the '70s or
the '80s. Let's substantiate this assertion.

As we saw above, descriptors such as
RMS level, integrated loudness, simplified
crest factor, and proportion of samples
above -1dBFS show spectacular evolution
from the beginning of the '90s until
sometime near 2005. This is the effect of the
loudness war. So surely the EBU’s loudness
range measure should do the same? As
shown on the first diagram of the group to
the right, it doesn’t. What we see is that
loudness range appears to be decreasing
from 1969 to 1980, then stabilises until
as expected, it follows a rather inconclusive
evolution, and certainly doesn’t increase in
any clear manner.

As we also saw above, the density of
high-level samples in the audio signal rises
spectacularly after the beginning of the '90s.
This indicates increasing use of compression,
and, more particularly, digital brickwall
limiters, which in turn raise the overall level
of the music corpus we’re dealing with. But
can the use of such limiters be linked to
a diminution in loudness range? Let’s answer
that question by displaying EBU 3342 values
versus high-level sample density — in other
words, by plotting loudness range versus
the amount of limiting applied. This is what
is displayed in the second diagram, which
shows extremely clearly that the answer
is no. The increasing amount of limiting
performed during the loudness war era
didn’t decrease the observed loudness
range in any way.

This is not to say that processing audio
with a brickwall limiter will not reduce
its loudness range. As we’ll see later in
the article, it does. The observation here
is just that, from the analysis of actual
records, the loudness war did not result
in any obvious reduction in the loudness
range of music.

Still, ‘loudness range’ as defined by EBU
3342 deals with time scales near and above
three seconds. Let’s see what happens
using other window analyses. For that, let’s
evaluate the gated RMS variability based on
0.05 to 12.5s-long windows. And to be even
more specific, let’s modify the evaluation
of RMS variability so that it singles out the
respective influence of each time scale.
This way, we will be able to see whether
the loudness war reduced level variability
at any time scale. The result for both
experiments are shown in the third diagram.
Not only does it corroborate the previous
findings, it also goes much further, showing

...
that the loudness war has had no clearly identifiable influence on level variabilities at any scale. This is quite a drastic conclusion: contrarily to what one can often read on the Internet, the loudness war did not cause any reduction in level variability. There is as much level variability now as there was in the '70s or '80s.

In order to confirm these findings, I asked Dr Damien Tardieu, signal processing specialist at IRCAM in Paris, to perform similar analyses on a totally different music corpus: 20,000 songs randomly selected from the EMI catalogue. Admittedly, the albums in this catalogue are referenced via copyright dates, so the analyses will be made a bit less reliable by compilations gathering older tracks under a more recent copyright, or by remastered editions. However, what we need here is a general estimation of a global phenomenon, so we can afford a slight margin of error. The fourth and fifth illustrations on the previous page show the evolution of loudness range measured according to EBU 3242, as well as the density of very loud samples corresponding to this corpus. They show that loudness range doesn’t decrease after 1990, even though limiting gets much more drastic. There is no doubt about it: contrary to general belief, there has been no obvious decrease in loudness range due to the loudness war, and brickwall limiters have not reduced the loudness range in music production.

So What’s Going On?

As we saw earlier, the amount of compression/limiting used in mastering drastically increased between 1990 and 2000. Yet at the same time, and even though limiting may in many cases reduce the loudness range of a piece of music (see ‘Loudness Range & Limiters’ box), it isn’t possible to observe an overall reduction in loudness range in productions. How can we resolve this apparent contradiction?

The first possibility is that mastering engineers may actually have been reasonable after all, only applying an amount of limiting that hasn’t led to obvious loss of loudness range. This, as shown in the ‘Loudness Range & Limiting’ box, is theoretically possible, since the audio material’s RMS variability may show a certain amount of resilience to limiting. I don’t believe this is the case, though. Significant limiting can be measured or observed on the waveform, and can easily be heard: attacks are modified in a very specific way, everything seems to be more dense, more solid, and often brighter. Having listened to a very large number of tracks from the corpus I used for this article, it’s obvious that a large proportion of recent tracks are limited in quite a heavy manner.

There remains only one solution I can think of: the loudness range of the music prior to mastering or even mixing has been increasing at the same time as compressing/limiting has been getting more drastic. In other words, the source material has more initial variability, and is more resilient to limiting. This is borne out by stylistic changes in music during the era of the ‘loudness war’. The beginning of the ‘90s, which correspond to the beginning of the loudness war, witnessed the emergence of mass-audience rap artists, and rap music typically has sparse production with very loud kick and snare parts, which increase
Loudness Range & Limiters

Limiters reduce loudness ranges, don’t they? Well, yes — and no. In fact, this issue is much more complex than it seems. Imagine you’ve got an audio file that is normalised: you can’t add any more gain without getting distortion. Using a limiter or a compressor on such a file will nevertheless add gain to its content: the RMS levels will be increased. This adds dynamic range to the medium: instead of being, in the case of a 16-bit file, 96dB, it will increase to perhaps 100 or 105 dB. On the diagram to the right, this additional available dynamic range is illustrated by the grey rectangle. From that point of view, limiters don’t decrease the loudness range, they increase it.

The idea that a compressor or limiter might expand the available dynamic range is interesting, but not true. Many decades ago, engineers would compress the signal between the microphone and the recorder in order to increase the available dynamic range of the recording medium, so that its then low signal-to-noise ratio was less of a problem.

The diagram shows the RMS analysis for three files: an original one, normalised but not limited, and the same file limited using a threshold of -6dB, then -12dB. Let’s focus on the difference between the original file and the -6dB one. As far as the low levels are concerned, the -6dB file gains 6dB of RMS. But the high levels are limited, so that the RMS gain for the high levels is only 5dB. This amounts to a RMS variability decrease of 1dB. Let’s lower the threshold slider to -12dB: the low levels gain another 6dB, but the high levels only 3dB. This corresponds to another RMS variability decrease of 3dB, a decrease of 4dB overall. So yes, from that point of view, limiters do decrease the loudness range — in that case, by an amount of approximately 4LU.

However, a 1dB loss in RMS variability is a very small amount. The threshold below which limiting really begins to affect the signal depends on the music you’re processing. The second diagram shows the evolution of RMS variabilities at different scales for three pieces of music. Notice how the pop/rock music piece on the right shows RMS variabilities that are more resilient to limiting than the other two pieces, which are opera and jazz. This is especially valid for the lower time scales: in that particular case, the limiter’s threshold had to be set to at least -6dB to get a noticeable decrease in RMS variability. This might very well be caused by the presence of a loud, very prominent kick drum part in this piece, which may indicate that the higher the initial RMS variability, the more its resilience to limiting. According to that point of view, high variabilities are not easily reduced.

This initial resilience to limiting is another argument towards the contention that limiting doesn’t automatically mean a reduction in loudness range, especially if the initial material is highly variable.

Level variability at very small scales (0.1s or so). Around the same time, metal music evolved into ‘nu metal’, which integrated elements of funk and rap, and with it more percussive elements. On a slightly larger time scale, this trend was at the end of musical phrases also evolved around the beginning of the ’90s. Whereas many hits from the ’80s would transition from one musical phrase to another using a mellow tom roll, hip-hop producers from the ’90s preferred drastic ‘cuts’ in the sound, which may be liable to increase level variability at scales near 0.5s.

On a still wider time scale, related to the structure of songs, one could point forward the idea that modern productions use contrasts in level, where older pop songs might have employed key or chord changes to delineate different song sections. It’s quite common to hear rap or even R&B tracks where the verses are so minimalistic it’s difficult to even extract a chord sequence from them, while at the same time, the chorus is buried under dense vocal harmonies and/or lavish tonal keyboard parts, which increase the RMS level quite a bit. ‘Lollipop’ by Lil’ Wayne or ‘Gangsta’s Paradise’ by Coolio are reasonably good examples, and so is, to a certain extent, ‘Single Ladies’ by Beyoncé. In productions like this, level variation is being used to create a structure for the song.

To illustrate the point, it’s interesting to compare two very different songs from different eras: the Beatles’ ‘Come Together’ (1969), and Lady Gaga’s ‘Telephone’ (2010). The top image overleaf shows RMS analysis for the two songs. The white lines indicate the song’s structural limits as annotated by ear. The two checkerboard-like diagrams show the self-similarity matrices for the RMS. In such self-similarity representations, the clearer squares indicate parts that are different from each other in terms of level, whereas darker squares indicate parts of similar levels. This comparison is a case in point: the large-scale level variations are greater in ‘Telephone’, and very much synchronised to the song’s structure. This is a single example, but helps provides a plausible explanation for the idea that large-scale RMS variability prior to mastering might be greater in the case of more recent music.

Can Limited Music Have Musical Dynamics?

Definitely. But the way musical dynamics are expressed may change.

Imagine you’re listening to some music. You want to get it louder: you walk to the volume control, and simply raise the volume. By doing so, you increase the signal’s RMS, increase its peak level, and leave its crest factor untouched. We’ll call that the ‘first loudness paradigm’. Suppose now that you’ve got a region in Pro Tools that peaks at 0dBFS. You can’t raise its volume in the traditional way, or it’s going to distort.

But you can insert a limiter, and lower its Threshold slider. By doing so, you still
increase the signal’s RMS, but this time its peak level remains stable and its crest factor gets reduced. That’s what we’ll call the ‘second loudness paradigm’.

When Wagner writes an orchestral crescendo, he uses the first paradigm, by adding more instruments. But, using limiters, you can create a crescendo that employs the second paradigm. The difference in terms of resulting waveform is illustrated in the top image below: Mike Oldfield uses the first paradigm at the end of the first part of Tubular Bells, while Trent Reznor resorts to the second paradigm in his track ‘Closer’.

To get a more precise idea of the difference between both paradigms, let’s take six crescendos from six different recordings, three of which use the first paradigm and three the second. Let’s analyse them in terms of RMS, peak level and crest factor. The result of this analysis is shown on the second diagram, right. The first graph shows that all crescendos are based on an increase in RMS level. The second graph clearly distinguishes the tracks that use the two paradigms: in case of the second, the peak level is constant. The third graph shows the crest factor systematically decreasing in these crescendos, but suggests that in the others, there is no link between crest factor and loudness. It could be argued that crescendos using the second paradigm are not ‘true’ dynamic events: the louder the music gets, the more the limiter is allowed to change the signal, and the more it will modify the original timbre. But is the same not true of traditional crescendos? Performing a crescendo on a single violin note will not only change its level, it will change its timbre. And most orchestral crescendos incorporate additional instruments as they develop. The combination of the two factors results in a much more drastic change to timbre than any brickwall limiter could ever cause.

The Case Of Death Magnetic
Metallica’s most recent album has become a cause célèbre for opponents of current mastering practices. As ‘as I can tell, the main problem with Death Magnetic is a collision between the way it has been mastered and its guitar sound. The very aggressive mastering simply is not suited to Metallica’s production style, which dates back to the ’80s and relies heavily on solid, distorted guitars. To sum it up, the result is a music that’s generally stable, and at the same time features very low crest-factor values. From a perceptual point of view, this translates as ‘compact at the time’.

Diagram 1 from the group on the final page shows a distribution of the 4500 simplified crest-factor values corresponding to the corpus we’ve been using for the article, along with the values for the tracks from Metallica’s Master Of Puppets and Death Magnetic. Analysis of other Metallica albums such as ...And Justice For All or the ‘Black’ album shows crest-factor values similar to those of Master Of Puppets. Looking at this diagram, we can see not only that all the tracks from Death Magnetic exhibit crest-factor values that are considerably lower than ‘normal’ Metallica albums, but that those values are simply extremely low compared to any music from the corpus.

Such crest-factor values are comparable to what can be found on tracks from Kanye West’s My Beautiful Dark Twisted Fantasy, or 50 Cent’s G Unit’s Da T.R.U.T.H. Those are stylistically loud urban music albums with really strong percussive elements that articulate the writing, and are better suited to low-crest-factor values than Metallica’s.

About The 4500 Tracks

Much of this article is based on analysis of a corpus of recorded music compiled from albums that achieved serious commercial and/or critical success. The main references are: Wikipedia’s best-selling albums page (see http://en.wikipedia.org/wiki/Best_selling_albums), chart archives from Billboard.com (www.billboard.com/#/charts/hot-100), and the ‘best ever albums’ web site (see www.besteveralbums.com). Additionally, when an artist is mentioned repeatedly on besteveralbums.com, the complete discography may be included. This is, for example, the case for Radiohead, Nirvana, Pink Floyd and U2. Each album from the corpus was verified as featuring mastering that could realistically have been performed at the time of the initial release — so if, for instance, a recording from 1970 displayed obvious digital brickwall limiting, it was rejected as being a re-master. Songs from compilations were referenced according to their original release date, not the compilation date, and checked for obvious remastering.
constantly buzzing guitars. They are also comparable to tracks from MGMT’s Oracular Spectacular or Congratulations, two albums with a sound so distinctive that a constant use of the second loudness paradigm and/or dynamic compression artifacts is not a problem at all. But Metallica’s ‘classic’ sound simply doesn’t easily allow for sonic extravaganzas.

Diagram 2, from the same group, shows Death Magnetic’s RMS variability in comparison to that of Master Of Puppets, as well as two other albums with low crest-factor values: My Beautiful Dark Twisted Fantasy and Congratulations. This is where the real trouble begins. Not only does Death Magnetic sound very ‘compressed’ because of its low crest-factor values, but it’s also very stable (low RMS variability). Which means it’s exaggeratedly compact... all the time. Diagram 3, from the same group, sums that up, by showing how unusual such a combination of low crest-factor values and reduced EBU 3442 loudness range is. It’s comparable to no more than three songs from MGMT. Even the sometimes incredibly compressed My Beautiful Dark Twisted Fantasy can’t compete: it retains much more contrast than Death Magnetic. And though it’s roughly as stable as the music of Dogzaba, an industrial metal band with death metal vocals who specialise in spectacularly loud, compact and thick productions, Death Magnetic is way more compressed. In my opinion, that does it: you don’t want traditional, mainstream metal to sound more compact than purposely extreme industrial/death metal. Or if you do, then you’ve got to change the music itself, to build in more contrast, so it can afford or even benefit from so much compression.

Is The Loudness War A Problem?

It’s easy to find people, documents, web pages and so on that unanimously blame the loudness war for damaging music. Many of them also link the loudness war to a reduction in “dynamic range”, though they usually don’t explain what dynamic range might be. Examples of such articles can be found online at http://skelfieldmusic.com/the-loudness-war-stops-here-high-dynamic-range-audio-recordings, http://dynamicrangeaday.co.uk/about/, on Wikipedia (http://en.wikipedia.org/wiki/Loudness_war#Dynamic_range_reduction), and even in the respected scientific magazine IEEE Spectrum (http://spectrum.ieee.org/computing/software/the-future-of-music). However, we’ve seen during this article that the loudness war actually didn’t result in any reduction in the closest well-defined descriptor there is to “dynamic range”, which is loudness range as defined by the EBU 3442 technical document. Neither is it possible to ascertain any decrease of dynamic variability at any scale.

So what’s the problem with the loudness war? Obviously, limiting does something ‘wrong’ with the signal, otherwise people wouldn’t be complaining so much — even though they apparently point at the wrong signal descriptor.

To answer that question properly, it may be useful to adopt a point of view that’s generally used in the field of image processing, according to which it’s possible to analyse a photograph or any picture in terms of luminance distribution. Photoshop does that in a dialogue called Levels. To evaluate such a distribution, an algorithm makes an inventory of all the pixels from the image, and sort them according to their luminance. This results into a distribution graph which shows if the picture, as a whole, includes predominantly light, medium or dark areas, and to which degree. The same process can be followed with audio files: we take an inventory of all the samples from a song, and sort them according to their absolute level. As shown on the image below, the resulting distribution curve can teach us many things.

Look at the mean distribution curve for songs produced in 2007. It peaks at a higher level than the mean curve for 1967 songs. This means the songs are generally louder in 2007. Than look at the ‘widths’ of both curves: they’re comparable, which basically means that something that’s closely related to dynamic variability hasn’t changed between 1967 and 2007. Now look at the little indentation at the right of the
2007 curve: songs from this particular year feature a density of high-level samples that’s unnaturally high: level distribution suddenly stops following Gauss’s normal distribution near the high levels. Compare the shapes of the two curves: it looks like the blue one was literally “pushed” towards the right. This shows the result of brickwall limiting.

To go on with the comparison with images, it’s just as if for the last 20 years, all pictures in books and magazines have been getting brighter and brighter. There are still deep blacks, the contrast remains intact, but all images look brighter. This is what is illustrated with the Tower Bridge pictures on the image below. It’s as if everything these days was supposed to look ‘flashy’, even though common sense suggests that there are some images that shouldn’t look flashy at all, in any situation. This is all the more true in the case of audio content, for which ‘brighter’ doesn’t simply mean a higher density of clearer pixels. It also means reduced crest factor, envelope modifications, use of the second loudness paradigm as seen above, and in the worst cases, distortion. Common sense suggests that although there is nothing wrong with these characteristics as such (you might as well say that using a violin is wrong), it’s a real problem to have them on virtually all records.

In the end, it’s all about style. Reduced crest factor values bring a ‘compact’ aspect to the sound; Waves describe it as a “heavily in-your-face signal that rocks the house” on their MaxxBCL page. It may be suited to your kind of music, or it may not. You might want to remain ‘soft’ on purpose. If you’re doing heavy techno music, though, “compact” is probably a good idea. Similarly, the two loudness paradigms described earlier each have a very distinctive ‘flavour’, and you may prefer one or the other: Do you want to have every loud attack modified by the compressor/limiter of your choice? It might be a good idea in many cases, but it might simply prove disastrous in others. Do you want to reduce the loudness range of your music without changing anything else? Then you’re probably better off with volume automation than with a limiter, since we saw that loudness range is naturally resilient to a certain amount of limiting.

The important thing in this matter is to know what you’re doing, and why, according to how you want your music to sound. Some specific tools can also help, such as the TT Dynamic Range Meter (see www.dynamicrangemeter.com/free-downloads — although this really measures the crest factor of the signal and not any kind of “dynamic range”). And if you like compression anyway, but you fear that Mr. Bob Dylan wouldn’t approve of your sound because it’s too “modern”, and resembles “static”, don’t worry. He’s probably not listening.

Comparisons between signal levels and picture levels as defined in Photoshop result in another interpretation of the loudness war.