Introduction
The terms “Loudness War”, “Level War” and “Loudness Race” describe the phenomenon of a constantly growing loudness of CDs containing popular music in the last two decades.¹ The expression “war” indicates that these terms not only describe the phenomenon itself, but also the negative side effects of increasing loudness. The terms have their origin in web forums, professional journals and books concerning mastering² and audio technology, where the topic is heavily discussed since approximately 1999.³ Those threads and articles show that there is awareness for the issue both in the professional audio industry and among “ordinary music listeners”. The ongoing discussions can be summarized in the following hypotheses:

– CDs with popular music are constantly getting louder since approximately 1990.
– Responsible for that are the artists as well as the producers and the A&R (Artists and Repertoire) Managers of the record labels. They want their CDs to be louder than the ones by competing artists.
– CDs are made louder mainly during the mastering process. The tools used for this are digital limiters and compressors.⁴
– The mastering engineers see the “Loudness War” as a negative trend, but they are forced to make CDs louder because otherwise they would lose jobs.
– The louder the CDs get the more distorted they are.
– There is no dynamics left on current CDs because of “overcompression”.
– Music without dynamics is boring and hard to listen to.

¹ In the following, the term “Loudness War” is used because it is the most common term.
² Mastering (or “Premastering”) is the last stage in the production process of a CD that follows up the recording and mixing of songs at a recording studio. The mastering is done at a specific mastering studio. During the mastering process, changes in level, tonality or dynamic range are implemented in order to get the various songs of a CD to sit comfortably alongside each other. Additionally unwanted material gets removed from the songs, they are placed in the correct order and the length of the gaps between the songs is decided (White (2000), p. 10). And, last but not least, the CDs are made louder. Bobby Owsinski (Owsinski (2000), p. 1) describes the mastering process as follows: “Mastering is the process of turning a collection of songs into a record by making them sound like they belong together in tone, volume, and timing (spacing between songs).”
⁴ You cannot make a CD louder by just boosting the level because the recording level of a CD is limited to 0dBFS. A higher level leads to severe distortions. Thus, compressors and limiters (also called: dynamics processors) are the ultimate tools to make CDs loud because they reduce the dynamic range of the signal first through which the level can be boosted to a certain extent without distortion. For further information on dynamics processors and for detailed information on how they are working see e.g.: Katz (2002), pp. 117.
The “Loudness War” is one of the reasons for the crisis in the record industry. Altogether the “Loudness War” is regarded negative in all those discussions. Particularly, plenty of criticism comes from mastering engineers. Bob Ludwig, one of the best-established people in this business says: “The levels getting louder and louder is an awful thing. It makes it hard to broadcast and hard to listen to!” Bob Katz (Digital Domain) adds: “...the broadcast and music recording disciplines have entered a runaway loudness race leading to the chaos at the end of the 20th century.” And Brian „Big Bass“ Gardners’ comment veers towards the same direction: „And with our levels today - with having to deal with always operating on the threshold of distortion - well, that’s always fun.”

Basically, three questions arise from the derived hypotheses:

1. Do CDs really get louder? If yes, to what extent?
2. Why are CDs getting louder and who is making them louder?
3. What are the consequences of the “Loudness War”?

To answer these questions, a number of quantitative and qualitative studies have been carried out in recent years. In this context, the following sections describe methodology and results of a study carried out to determine the loudness of CDs.

**Loudness measurements of CDs with popular music**

**Methods**

The study included a selection of 32 individual songs and 36 complete CDs. The first step was to determine measurement tools that are able to predict the loudness of music. Helpful in the decision making was the research carried out by the SRG 3 (“Special Rapporteur Group”) within the ITU-R (International Telecommunication Union Radiocommunication Sector). The SRG 3 aims to define a standard for broadcast loudness measurement. They have completed studies where the loudness of typical broadcast material (speech, music etc.) first had been measured with test persons in listening tests. Afterwards those subjective loudness measurement results were correlated with “objective” measured loudness values from loudness measurement tools. To summarize the results, an \( L_{eq} \) (“equivalent continuous sound level”) measure with a slight \((L_{eq}(RLB))\) or no frequency weighting \((L_{eq}(LIN))\) is presently the best tool to measure the loudness of music and speech. The correlation between “subjectively” and “objectively” measured loudness values exceeds 95% for both methods. Surprisingly

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7 Droney (2002a): p. 3
8 For the complete study see von Ruschkowski (2006).
9 The measurement of loudness is a quite complex issue (as it is for other sensations). For further information on this topic see e.g. Zicker, Fastl (2007) or Moore (2003).
complex loudness models like the one by Zwicker were not working properly when measuring “natural” sounds like music or speech.\textsuperscript{10} Thus $L_{eq}(RLB)$ and $L_{eq}(LIN)$ were chosen for the loudness measurements in this study. The $L_{eq}$ corresponds to an (energy domain) average over a time interval $T$ during which the sound level is measured. The unit of the $L_{eq}$ is dB and it is mathematically defined as follows:

$$L_{eq}(W) = 10 \log_{10} \left( \frac{1}{T} \int_{0}^{T} \frac{x_W(t)^2}{x_{Ref}(t)^2} dt \right) dB$$

$$= 20 \log_{10} \left( \sqrt{\frac{1}{T} \int_{0}^{T} \left( \frac{x}{x_{Ref}(t)} \right)^2 dt} dB \right)$$

$W$ stands for the chosen frequency-weighting filter and $x_W(t)$ for the frequency-weighted sound pressure of the measured signal at time $t$. $x_{Ref}(t)$ is the sound pressure of the reference signal. The second formula shows the $L_{eq}$ as a root-mean-square (RMS) type of measurement which is transformed into dB.\textsuperscript{11} The term RMS is frequently used instead of $L_{eq}$.\textsuperscript{12} Fig. 1 shows the RLB-weighting-filter curve:

\textbf{Fig. 1:} Frequency response of A, B, C, D, M- and RLB-weighting filters. The levels of the curves are chosen in a way that 0 dB is always reached for 1 kHz (Skovenborg, Nielsen (2004), p. 7).

\textsuperscript{12} Soulodre (2004), p. 5; Spikofski (2004), pp. 6. The software Wavelab 6 by Steinberg which was used for the measurements presented in this paper also uses the term RMS.
For this study, two measurement devices on software basis were used. LMCU 1.3 by ABC Technology Research & Development, which measures $L_{eq}(RLB)$ and Wavelab 6 by Steinberg, which measures RMS(LIN). Both programs were running under Windows XP on a laptop computer (Fujitsu Siemens Amilo M1425) with a 1.6 GHz processor and 512 MB RAM. The songs can be read into the programs for the measurement. There is just one loudness value for each song or CD, which was considered a problem at first glance. But further research showed that at least for popular music, one loudness value is quite representative for the loudness of a whole song and even for entire CDs.\(^{13}\)

Both programs measure loudness (a sensation) in dBFS, which is a physical unit. Hence there are some things to consider when interpreting the results. The values are at most on ordinal scale level (because it is a sensation) and thus absolute evidence regarding the changes of the loudness of CDs is not possible. As mentioned above, loudness models like the one by Zwicker that measure loudness in sone and thereby attempt to bring a sensation on a ratio scale level are not working properly. From this it can be concluded that with the measured loudness values from LMCU 1.3 and Wavelab 6 one just can make a statement such as: "The loudness of CDs has increased heavily in the last 10 years." Conclusions like: "The loudness of CDs has doubled in the last 10 years" are not possible.

Media

For the study, only CDs that contain music released after 1982 (the year the CD was introduced to the public market) were used. For earlier recorded music, it is often uncertain if, how and particularly when the music has been mastered before being pressed on CD. Seven artists, altogether representing a big variety of musical styles, were chosen: Sting, David Bowie (rock and pop music), Beastie Boys (hip hop), Depeche Mode (electronic music), Danzig (hard rock/heavy metal), Prince (rhythm and blues) and Die Ärzte (punk). For four artists, the loudness of entire CDs was measured (number of CDs in parentheses): The Beastie Boys (6), Depeche Mode (10), Prince (12), Sting (8). For the other three artists, the loudness of individual songs was measured (number of songs in brackets): Die Ärzte (10), David Bowie (13), Danzig (9). The individual songs from the artists were chosen in a way that they had a similar character (ballad, up-tempo-song, rock song etc.) to ensure comparability.

Results

Fig. 2- Fig. 8 show the results of the study. The horizontal axis is the release year and the up axis the measured loudness value in dBFS:

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\(^{13}\) von Ruschkowski (2006), pp. 78.
**Beastie Boys**

![Graph showing loudness values for six CDs of the Beastie Boys]

**Fig. 2:** Loudness values for six CDs of the Beastie Boys. Measured with LMCU 1.3 and Wavelab 6.

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**Depeche Mode**

![Graph showing loudness values for ten CDs of Depeche Mode]

**Fig. 3:** Loudness values for ten CDs of Depeche Mode. Measured with LMCU 1.3 and Wavelab 6.
**Fig. 4:** Loudness values for twelve CDs of Prince. Measured with LMCU 1.3 and Wavelab 6.

**Fig. 5:** Loudness values for eight CDs of Sting. Measured with LMCU 1.3 and Wavelab 6.
Fig. 6: Loudness values for ten songs of Die Ärzte. Measured with LMCU 1.3 and Wavelab 6.

Fig. 7: Loudness values for thirteen songs of David Bowie. Measured with LMCU 1.3 and Wavelab 6.
Overall it is visible that the loudness of the CDs has grown for all the artists. In all seven cases, the current CD was the loudest. Furthermore the following observations were made:

- For the 1980ies, the trend of the development of loudness shows to a lesser extent an increase of loudness, but rather a stagnation or a slight decrease. Only in one case the loudness increased. In two cases, the loudness stagnated and in three cases it decreased. In one case (Danzig) a trend could not be identified because of missing releases in the 1980ies.
- Towards the end of the 1980ies and at beginning of the 1990ies, the loudness increased nearly uninterrupted for all seven artists to this day. In six cases, the growth was more intense in the period from 1987 to 1994 than from 1995 to 2006. In one case, the maximum growth fell between 1995 and 2006.
- From the mid-1990ies on, the increase of loudness slowed down.
- For twelve of the fourteen cases, the overall increase of the RMS(LIN)- and $L_{eq}(RLB)$-values lay between 9-12 dB$_{FS}$ (Fig. 9).
In one case the value is lower (6.6 dB FS) and in one case higher (13.6 dB FS). The arithmetic mean is 10.7 dB FS for the RMS(LIN)-values and 10.5 dB FS for the $L_{eq}(RLB)$-values. The standard deviation is 2 dB (RMS(LIN)) and 2.3 dB ($L_{eq}(RLB)$) respectively.

It has to be stated again, however, that the RMS(LIN)- and $L_{eq}(RLB)$-values in dB FS are (when measuring a sensation like loudness) not on ratio scale level and thus absolute evidence about the changes of the loudness of CDs is not possible (see above). However those values show at least a clear trend: the loudness of CDs with popular music has increased heavily over the last two decades. Also noticeable is the trend of a disproportionately intense growth of loudness in the period from 1987 to 1994.

The following chapter tries to find an explanation for this phenomenon.

**Premises and reasons for the „Loudness War“**

**Premises**

The literature basically mentions two premises for the “Loudness War”: The invention of the CD and the invention of digital limiters and compressors.

In vinyl-disc times, the possibilities to influence the sound of the recordings during the mastering were limited because of the technical limitation of the medium. Vinyl mastering was (and still is today) a compromise between sound, level and duration of the music. Technically, approximately 30 minutes of music are possible per side of a long-playing record, if losses in level and bass-frequencies are accepted. Music with a heavy bass can reduce playing time to approximately 10 minutes per side. A high level also
reduces the playing time of a record, because more level leads to broader grooves. In times when vinyl discs were the preferred sound storage medium compressors and limiters were also used to make the records as loud as possible. However the mastering engineer had to take care not to overuse the dynamics processors because otherwise with too much loudness the needle of the record player would jump out of the groove while playing the record. Music mastered too loud always bore the risk of financial losses due to not “playable” records.

The situation changed in the mid-1980ies when the Compact Disc (CD) started to replace vinyl discs as the preferred sound storage medium. The mastering engineers were not constrained by the limitation of the sound storage medium anymore, like Bob Ludwig points out: “It [the invention of the CD] gave us freedom to concentrate even more on the creative without having to worry about the mechanical worries of vinyl.”

There is hardly any technical limitation for the CD. Playing time is neither depending on the amount of bass frequencies nor on the level. And, important in conjunction with the “Loudness War”, heavily limited and compressed music causes no problems on a CD. Thus the invention of the CD is one premise for the fact that music is mastered as loud as it is nowadays.

The improvement of dynamics processors is another premise for the “Loudness War”. Digital dynamics processors, which have been available since approximately 1990, caused a revolution in mastering like Bob Katz confirms: “I can cut a CD that’s 16 dB louder than the ones we made in the early 90’s, before digital limiters became popular.....”

Hence digital dynamics processors are broadly seen as the main premise for the “Loudness War”. This can be proved by statements from mastering engineers. Being asked about the main premises for the “Loudness War” Bob Ludwig points out: “The invention of digital domain “look-ahead” compressors. Thank God they weren’t invented when the Beatles made their music.”

The measurement results also show evidence for a strong correlation between the “Loudness War” and the invention of digital dynamics processors. The first digital dynamics processors were available around 1990 and the results of the measurements show a trend of a disproportionately intense growth of loudness for just this period.

Altogether it seems like the phenomenon “Loudness War” is based on two premises that are linked with each other. On the one hand, music can be mastered as loud as it is today because digital dynamics processors give mastering engineers the chance to do so. On the other hand with the CD a music storage medium has been invented that is capable of storing music mastered that loud.

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19 Jackson (1999), p. 1; Owsinski (2000), p. 3; Daniel Weiss (Weiss Digital Audio) via email; Peter Poers (Jünger Audio) via email.
Reasons for the „Loudness War“

The most frequently named reason for the battle for the loudest CD is of an economical nature: The “Loudness War” stems from the desire of the people in charge (artists, producers, A&R Managers) to produce a CD that’s louder than those by competing artists. There is a current opinion that louder CDs sell better on the market, in other words there is belief in that maximum loudness is appealing to the listeners. A parallelism can be seen between this trend and a trend in broadcast where every radio station tries to have the loudest signal as Robert Orban and Frank Foti describe: “Just as radio stations wish to offer the loudest signal on the dial, it is evident that recording artists, producers, and even some record labels want to have a loud product that stands out against its competition in a CD changer or a music store’s listening station.” In both cases a signal as loud as possible is produced to stand out from the crowd. During the mastering CDs from competing artists serve as a standard to outbid. This results in a vicious circle with a permanently increasing loudness because the pressure of being louder than the competitors always remains. Bob Katz describes the situation as follows: “Producers don’t seem to like making a CD that’s even a little softer than the competition, so each succeeding CD is often a little bit hotter.” Brian Gardner adds: “They always wonder, “Can’t you make this a little louder?” It keeps moving up.”

An exploratory study showed the relevance of this issue for the music industry. Nine out of thirteen interviewed artists, A&R Managers and producers (69 %) confirmed that loudness plays an important role during the mastering of their CDs. The tendency to produce records with progressively increasing levels is not a new issue. The “Loudness War” has been existing since the 1960ies. But the technical limitations of vinyl disc defined an upper limit for loudness. This upper limit ceased to exist with the invention of the CD and thus the pressure on the mastering engineers to produce louder records was growing.

The mastering engineers are forced to take part in the “Loudness War” against their will because otherwise they would lose business. Dave Collins describes his situation as follows: ”I have to play the game because if you want to stay in the business, you’ve got to compete on absolute level, but it’s really a horrible trend.” Bob Ludwig’s comment points in a similar direction: ”And for me, I’m under pressure from A&R people and clients to have things loud,...."

Interestingly there is no scientific study until today that has proved a direct connection between loudness and commercial success. Nevertheless “louder” is often equated with “better”. This phenomenon is explainable in a certain way: With an unchanged volume

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control the more compressed the music the louder it is. To a certain degree louder music contains more high and bass frequencies, a circumstance explainable with the “equal loudness contours”. Those “extra” frequencies make the music sound more brilliant and warm, something that most listeners prefer. But after readjusting the volume of less compressed or uncompressed music the same effect can be observed. Therefore loud CDs only exhibit advantages in situations where the volume isn’t usually readjusted, which is very rare (e.g. CD changers for background sound reinforcement in pubs). In most listening situations the volume is adjusted by the listener or the DJ. In those cases loud CDs do not have an advantage. In radio airplay, even disadvantages occur as radio stations compress and limit the signal before it is broadcasted and music that already has a reduced dynamic range causes undesired side effects like distortion.

The “Loudness War” might also be caused by the ongoing changes in the production process of music, i.e. that the music is inherently louder before it is mastered. But to what extent new technology (like digital audio workstations) has influenced the loudness of unmastered music is a controversial question. Some mastering engineers like Bob Olhsson report on a growing loudness of unmastered music: “...that people are commonly going too far with compression during mixing so much that an awful lot of mixes can’t be helped.”\(^\text{29}\) In contrast other mastering engineers like Brian Gardner don’t observe any differences with the material that they master. He answers the question if the source material delivered for mastering is louder than in the past: “No, not necessarily how it comes in; it’s just they want the end product to jump.”\(^\text{30}\) It is likely that the changes in the production process of music did have an influence on the “Loudness War”, but to what extent remains questionable.

Another reason for the “Loudness War” could lie in the fact that the way of listening to music has changed. Instead of listening at home, music is more and more consumed en-route via MP3 player or a car CD player. Hence with this way of listening to music other aspects than the sound become important. A reduced dynamic range (and thus a greater loudness) can help to prevent music that’s listened to en-route from vanishing in the background noise.\(^\text{31}\) The mastering engineers have to respond to this changing situation. Paul Stubblebine describes the new challenge as follows: “Parallel to that trend over the last ten years we have seen an increase in the end-user listening environments that we have to consider. Back then, we concerned ourselves primarily with how the record would sound in the "average" living room and how it would sound on the radio. Now a large part of the audience listens on Walkman-style headphones. A substantial part of our audience is listening in a car.”\(^\text{32}\) Nowadays during the mastering session the mastering engineer has to find a compromise that satisfies all music listeners and all listening situations respectively. According to this, it is likely that this changed situation has an influence on the “Loudness War”. However, the dynamic range is reduced to a


larger degree actually necessary to allow the consumption of music en-route in a comfortable way.\textsuperscript{33}

**The consequences of the “Loudness War”**

As consequences of the “Loudness War” the increase of audible distortion and the loss of the dynamics in popular music are frequently mentioned.\textsuperscript{34} Distortion and reduced dynamic range are indeed detectable on a physical level. But how they affect the listener’s sensation remains unknown. Scientific studies on those topics haven’t been done yet. The following remarks base therefore on individual comments.

*Distortion*

The excessive use of dynamics processors results in measurable and audible distortion. Mastering engineer Bernie Grundman describes his sensations while listening to current CDs as follows: “It’s all smashed and smeared and distorted and pumping. You can hear some pretty bad CDs out there.”\textsuperscript{35} Bob Katz states: “To say nothing about distortion. Are we really in the business of making square waves? Why has the average sound quality of popular music CDs gone downhill since the introduction of the digital medium,…..”\textsuperscript{36} Those distortions arise from the exaggerated use of dynamics processors during the mastering process and are for the most part caused by the so called “clipping”. Clipping occurs on the one hand if the signal overloads in the digital domain. This can be the case in every part of the (digital) recording chain. On the other hand “clipping” is used as mode of operation in digital limiters. The algorithms are programmed in a way that short peaks are cut out of the signal electronically to raise the level afterwards. Those “clipped” waveforms have a flat top (see Fig. 10) like a square wave:

![Clipped Waveform](image)

**Fig. 10:** „Clipped“ Waveform (Katz (2002), p. 273).

\textsuperscript{33} Jones (2005), p. 2.
\textsuperscript{35} Owsinski (2002), pp. 9.
\textsuperscript{36} Katz (2002): p. 188.
“Clipping” is not audible if only a few short peaks are “clipped”. But nowadays with the excessive use of digital limiters in mastering a large part of the music signal is “clipped”. Nielsen and Lund showed in a study that the number of “clipped” waveforms on CDs has grown in recent years. In consequence of that the total harmonic distortion (THD) increases, which results in audible distortion. Moreover with those distorted signals further problems occur in broadcast, while using lossy data compression algorithms and in electronic devices from listening units like CD players.

In radio stations the dynamics of the broadcast signal is heavily processed with devices like the Orban Optimod. For music that already contains THD, the treatment makes everything worse like Robert Orban and Frank Foti conclude: “Hypercompressed material does not sound louder on air. It sounds more distorted, making the radio sound broken in extreme cases.” The European Broadcasting Union (EBU) is aware of this problem and warns their members of the excessive dynamics treatment of the broadcast signal.

When music is listened to via a CD player, another problem may occur. Many of the built-in electronic devices (e.g. analog-to-digital converters) are not designed for operation with signal levels that hot like from current CDs. In consequence, the already existing distortion gets aggravated because of overloading electronic devices. Nielsen and Lund showed in a study that CD players of all price ranges have difficulties in handling those signals. And not only CD players, but all kinds of digital music equipment. Thomas Lund recapitulates: “We have documented that current consumer, music, film and broadcast equipment has not been designed for levels this hot.”

If music is processed with lossy data compression algorithms like the popular MPEG-1 Audio Layer 3 (in short: mp3) similar problems occur. Those algorithms have difficulties with the processing of hot levels and are exceedingly susceptible for already existing distortion. The amount of THD rises proportionally with the diminishment of the bitrate. For a data reduction free of artefacts, for current music it is necessary to reduce the level at least by 3 dB before processing. How an average music listener perceives the distortion caused by “clipping” in current music, and whether it is sensed at all remains unknown. Nielsen and Lund suppose that today’s music is tiring because of the distortion but studies on this topic are lacking. In this context again attention should be paid to the fact that the majority of the listeners nowadays consumes music en-route and/or in data reduced formats like mp3. This can be taken as an indication that the relevance of sound quality for the listeners is declining. Eventually it remains questionable if someone who is used to listen to mp3 files downloaded from the internet in often miserable sound quality is bothered by an increase of THD.

Loss of musical dynamics

A further consequence of the “Loudness War“ is the ongoing loss of musical dynamics in today’s popular music. In some cases the dynamic range has been reduced to 2-6 dB. But how the missing dynamics affect the listener’s sensation remains unknown. Scientific studies on this topic are not available yet and so the only usable sources of knowledge are comments on this topic from individuals, mostly from audio experts with trained ears.

It is said that the absence of dynamics makes music lifeless and boring and that listening to “overcompressed” music is exhausting and stressful because of the missing transients. Bob Ludwig describes that as follows: “To me, it’s a fact that highly compressed music is tiring to the ear and doesn’t make you want to listen to something over and over again.” He assumes that this situation is one of the causes for the decreasing record sales over the past years: “Could this be one of the reasons for the record industry’s demise?”

However it remains questionable if average listeners sense “overcompressed” music in the same way. Their way of listening to music differs from the analytic listening of mastering engineers and other professionals of the audio sector. Music is listened to more and more en-route and in that case reduced dynamics are rather beneficial than disturbing. Whether an average listener thus perceives a reduced dynamic range as acceptable, or if and when the negative effects of the dynamics reduction outweigh, remains in question.

Nevertheless opinions from audio experts like mastering engineers should be taken seriously because dealing with musical dynamics has been part of their everyday work for decades. And dynamics themselves have been part of music for centuries, but in today’s popular music have lost significance. Some listeners (and musicians) might by now have forgotten that music, similar to movies, relies on moods and elements of surprise caused by dynamics.

In this context, yet another phenomenon that temporarily appears in “overcompressed” music becomes important: the so-called “dynamics inversion”, which Glenn Meadows describes as follows: “Spots in the record that should get louder actually get softer because they’re hitting the compressor/limiter too hard.” In this case the “overcompression” leads to a turnaround of the musical intention embodied by the dynamics.

Conclusions

This paper dealt with the so-called “Loudness War”, the phenomenon that the loudness of CDs with popular music has increased heavily over the past two decades. In a study with 32 songs and 36 CDs by seven different artists it could be demonstrated that the loudness has been grown nearly uninterrupted since the end of the 1980ies to this day. Thereby, the growth was most intense in the period from 1987-1994. From the mid-

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1990ies the increase of loudness slowed down but nevertheless the newest CD was in all seven cases the loudest.

Furthermore it could be shown that CDs are made louder especially during the so-called mastering and that the “Loudness War” is based on two premises that are linked with each other. First of all with the CD a music storage medium has been invented that is capable of recording music that is as loud as it is nowadays. Secondly music can be made as loud as it is today during the mastering because digital dynamics processors give mastering engineers the chance to do so.

The main reason for the “Loudness War” is the effort of the musicians, A&R Managers and producers to have louder CDs than competing artists. There is a widespread belief in that loud CDs sell better on the market. However not only there is a lack of scientific studies that could affirm this hypothesis but also logic speaks against it. In most cases listeners adjust the loudness of music for themselves. Another reason for the “Loudness War” could lie in the fact the way of listening to music has changed. Music is more and more listened en-route. And one must confess that there are some benefits with dynamics reduced music in those listening situations. A reduced dynamic range (and thus a greater loudness) can help to prevent music that is listened to en-route from vanishing in the background noise. But the dynamic range of the music is reduced way beyond what is necessary to listen to it comfortably en-route.

In the last part two consequences of the “Loudness War” that are frequently mentioned in the literature were presented: the increase of audible distortion and the loss of the dynamics of music. Both are indeed detectable on a physical level. But how they affect the listeners’ sensation remains unknown because scientific studies on those topics are missing. Distortion occurs at first because the signal is “clipped” during the mastering in mastering processors like digital limiters to make it louder. Afterwards the distortion is frequently being aggravated for example due to further processing before being broadcasted, while using lossy data compression algorithms or because of overloading electronic devices in listening units like CD players. All that leads to an increase of THD in popular music. However in this context it is important to mention that it seems like the relevance of sound quality for the listeners is declining. So it remains in question if they are bothered by an increasing THD.

Dynamics has been part of music since centuries. The dynamic range of CDs has declined over the past years because increasing the loudness with dynamics processors leads to a decrease of dynamics. How a reduced dynamic range affects the listener’s sensation in not known. Some professionals of the audio sector assume that the absence of dynamics makes music lifeless and boring and that such music turns into a stress factor. Further research on this topic and how distortion in music is sensed seems to be necessary.

References


