



Normally Hearing Listeners' Perceptions of Dynamic-Range Compressed Music

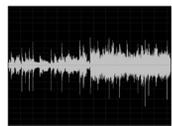
Naomi B.H. Croghan¹, Kathryn H. Arehart¹, James M. Kates^{1,2}

¹Speech, Language, and Hearing Sciences, University of Colorado at Boulder, ²GN ReSound

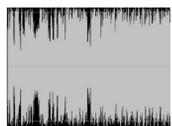
Introduction

- Current knowledge of how to design and fit hearing aids to optimize music listening is limited. Additionally, many hearing-aid users listen to recorded music, which often undergoes processing before arriving at a hearing aid.
- Dynamic-range compression (DRC) is used in the music industry to maximize loudness, due to a common perspective in the industry that “louder is better.”
- Some artists and consumers argue that excessive use of DRC negatively impacts the quality of music, causing a backlash against the high levels of DRC that have been applied in recent years.³
- DRC may have perceptual consequences for normally hearing listeners and hearing-aid users. This study took a first step toward understanding how DRC affects the perceived loudness and quality of music by asking the question, “**is louder better?**”

Stimuli



Original rock recording



Heavily compressed, UNEQ



Heavily compressed, LEQ

Un-mastered recordings of rock and classical music were processed with varying compression thresholds, using the Massey L2007 Mastering Limiter plug-in for Pro Tools.

Un-Equalized Condition (UNEQ): No equalization was applied following DRC processing, which allowed loudness to vary greatly among different levels of compression.

Loudness-Equalized Condition (LEQ): Following DRC processing, stimuli were equalized in loudness to the original recording using a time-varying loudness model².

Procedure

- Participants judged music samples using a six-point scaled paired-comparison method¹.
- Stimuli were presented over earphones at an average level of 65 dB SPL.

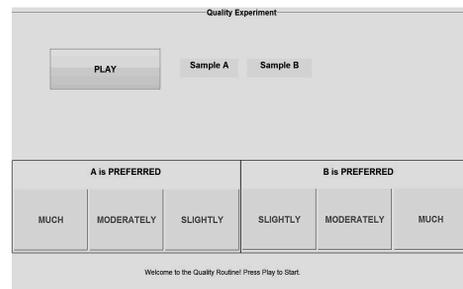


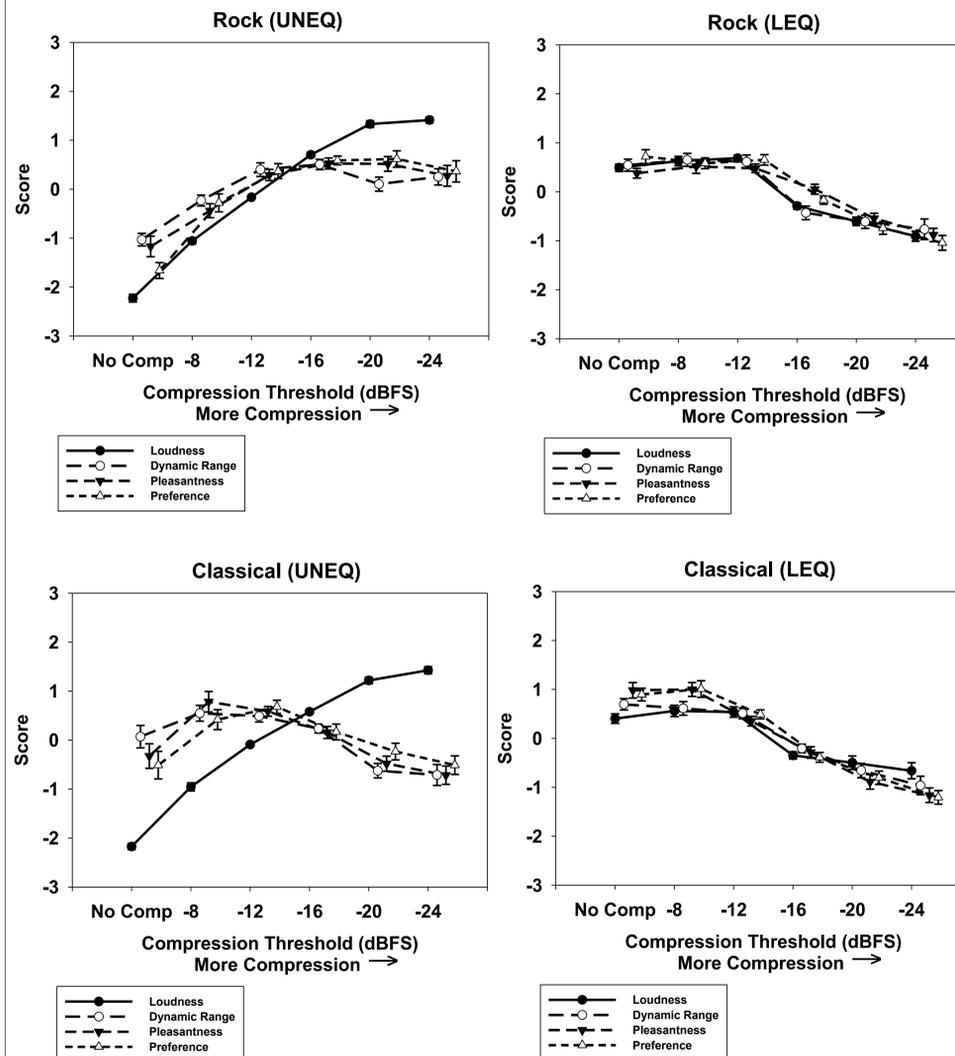
Table: Randomized Test Blocks

Block	Genre	Loudness Condition	Scales	DRC Threshold Conditions
1	Rock	UNEQ	Loudness, Dynamic Range, Pleasantness, Preference	None, -8, -12, -16, -20, -24 dBFS
2	Rock	LEQ	Loudness, Dynamic Range, Pleasantness, Preference	None, -8, -12, -16, -20, -24 dBFS
3	Classical	UNEQ	Loudness, Dynamic Range, Pleasantness, Preference	None, -8, -12, -16, -20, -24 dBFS
4	Classical	LEQ	Loudness, Dynamic Range, Pleasantness, Preference	None, -8, -12, -16, -20, -24 dBFS

Participants

Group	N	Age Range (yrs)
Normally Hearing Musicians	14	18-40
Normally Hearing Non-Musicians	9	23-60

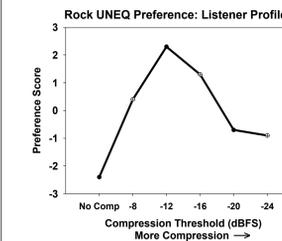
Results



- Error bars represent standard error.
- Compression had a significant effect for all scales and for both genres in UNEQ and LEQ conditions ($p < 0.05$).
- UNEQ: perceived loudness increased with increasing DRC. Preference, pleasantness, and perceived dynamic range increased with low levels of DRC, while higher levels of DRC either had no effect or were detrimental.
- LEQ: perceived loudness, perceived dynamic range, pleasantness, and preference all decreased with increasing DRC.

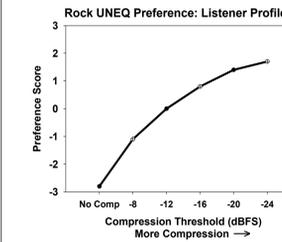
Variability Across Listeners

No significant differences were found between musician and non-musician groups. However, substantial individual variability was observed among listeners, particularly in the UNEQ condition.



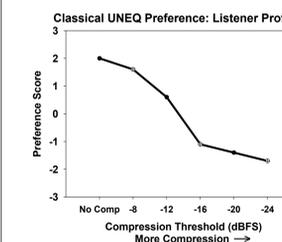
Listener Profile A:

- Low levels of DRC were preferred to none, but high levels of DRC were less preferred.
- May be due to a positive loudness-preference relationship to a point, after which distortion caused by DRC becomes detrimental.
- 13 listeners (rock); 16 listeners (classical)



Listener Profile B:

- Higher levels of DRC were preferred to lower levels of DRC.
- May be due to loudness trumping distortion, so louder samples are always preferred.
- 10 listeners (rock); 3 listeners (classical)

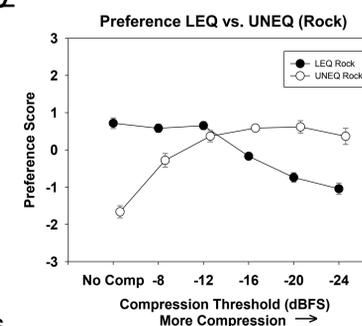


Listener Profile C:

- Lower levels of DRC were preferred to higher levels of DRC.
- These listeners may be particularly sensitive to distortion.
- 4 listeners (classical only)

Summary

- Low levels of DRC were preferred when loudness varied (UNEQ) and did not affect preferences when loudness differences were minimized (LEQ). High levels of DRC were either detrimental or had little effect.
- All listeners, including non-musicians, were sensitive to quality and loudness changes due to DRC. Individual preferences varied.
- **Louder is better . . . to a point.** Contrary to the “louder is better” mentality in the music industry, the current findings suggest that distortion caused by high levels of DRC leads to lower perceived quality in most cases. The effects of DRC should be considered when designing hearing aids for listening to recorded music.



References

¹Dillon, H. (1984). *A procedure for subjective quality rating of hearing aids*. (NAL Report No. 100). Sydney, Australia: National Acoustic Laboratories.

²Glasberg, B.R., & Moore, B.C.J. (2002). A model of loudness applicable to time-varying sounds. *Journal of the Audio Engineering Society*, 50, 331-432.

³Vickers, E. (2011). The loudness war: Do louder, hypercompressed recordings sell better? *Journal of the Audio Engineering Society*, 59, 346-351.

Acknowledgments

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