Centre for Interdisciplinary Research in Music Media and Technology

McGill University

SUBJECTIVE EVALUATION OF MP3 COMPRESSION FOR DIFFERENT MUSICAL GENRES

Amandine Pras[1], Daniel Levitin[2], Rachel Zimmerman[2] & Catherine Guastavino[1]

CIRMMT & McGill University
[1]School of Information Studies
[2]Department of Psychology

History of mp3

- Defined by the *Motion Picture Expert Group* (MPEG) in 1991 as an open format
- Initially for storage, to reduce digital music file size
- Has become a commercial format

Very popular, people tend to listen to music only in mp3

What is mp3?

- A digital CODEC = an algorithm to encode and decode the signal
- Lossy audio standard
- Flexible: users select a bit rate (# bits/s)

determines the compression factor

lower bit rates = smaller files

but more distortion and artifacts

How does mp3 work?

- Audio signal decomposed into 32 frequency sub-bands
- Each sub-band is processed based on psychoacoustic model (frequency and temporal masking)
- Quantization depends on bit rate (compression factor)

Are mp3 compression artifacts audible?

- Novices only hear difference between CD quality and low bit rate of 96 kb/s (Salimpoor, 2006)
- Experienced sound engineers prefer CD quality to mp3 files even at high bit rates of 320kb/s (Sutherland, 2007)
- Tolerance to compression for bit rates ranging from 32 to 192 kb/s varies as a function of musical genre (Ruzanski, 2006)

Our research questions:

- Can trained listeners (musicians or sound engineers) hear differences between mp3 files (96-320 kb/s) and CD quality files?
- Which format do they prefer?
- Does preference depend
  - on musical genre?
  - on listener's expertise?
  - on listening habits?
- Can trained listeners verbalize which types of sound criteria were introduced by mp3 compression?

Methods

- **Participants**
  - 13 trained listeners, mean age of 28 (SD=5.6) with studio experience (mean of 6 years, SD=5.2)
    - 4 musicians
    - 9 sound engineers
- **Sound samples**
  - 5 short musical excerpts (musical phrase < 10sec.)
  - Different musical genres
  - 6 formats: wav and mp3 at 96, 128, 192, 256, 320 kbits/s
  - L.A.M.E. mp3 encoder

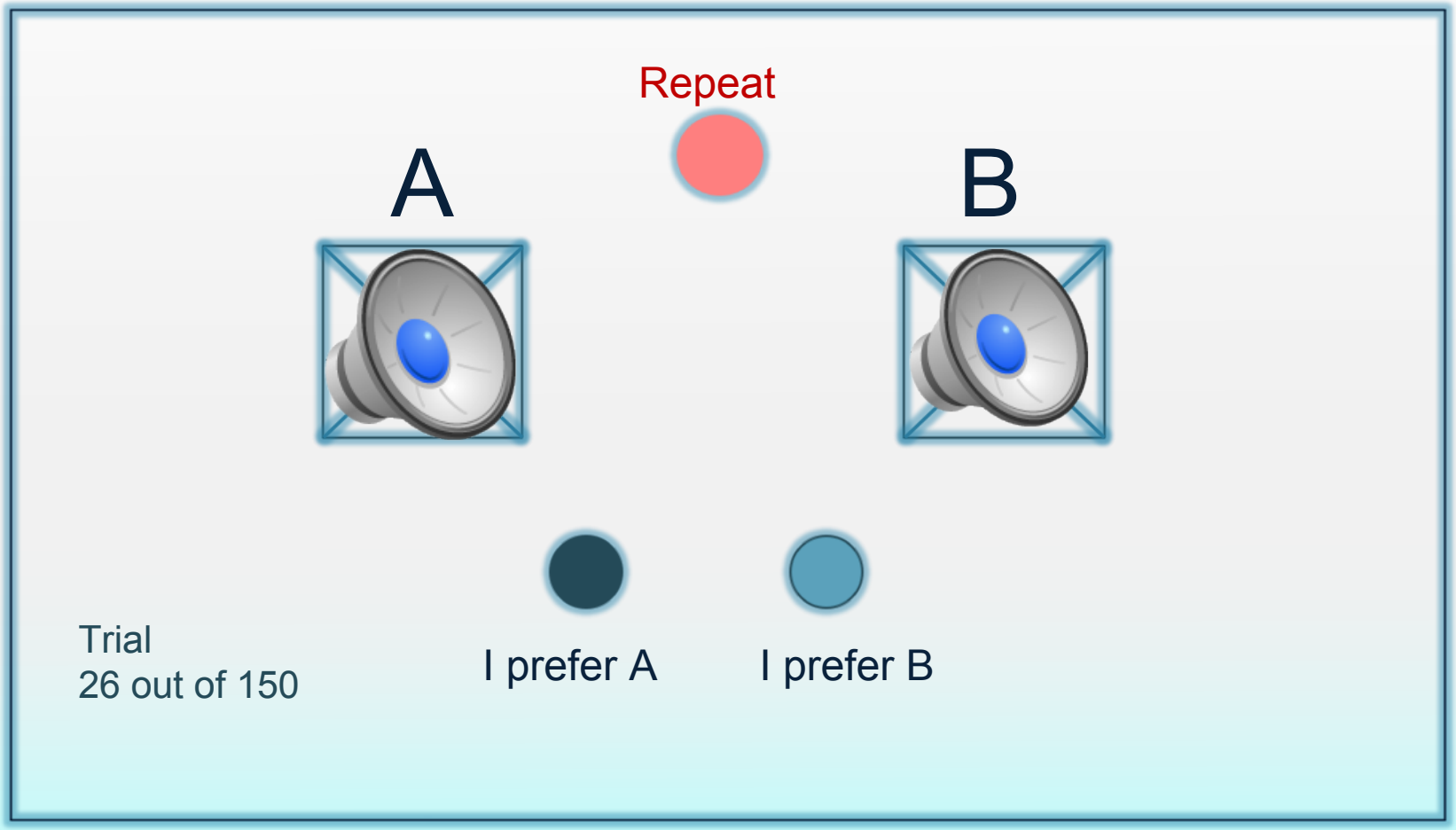
Sound samples

Musical genre	Name of the piece (tune)	Composer	Performers (band/orchestra)	Additional Information
Pop 	Irish Green	Bart Moore	Slings & Arrows	Produced by Daniel Levitin
Metal rock 	Killing in The Name	Rage Against the Machine	Rage Against the Machine	Produced by Garth Richardson
Contemporary 	Diffraction	Yoshihisa Taïra	Quatuor Ixtla	Produced by Amandine Pras
Orchestra 	Symphonie #5	Gustav Malher	Wiener Philharmoniker directed by Pierre Boulez	Deutsche Grammophon
Opera 	Lascia ch'io pianga	George F. Handel	Not listed	Anechoic recording by Angelo Farina, downloaded from www.angelofarina.it

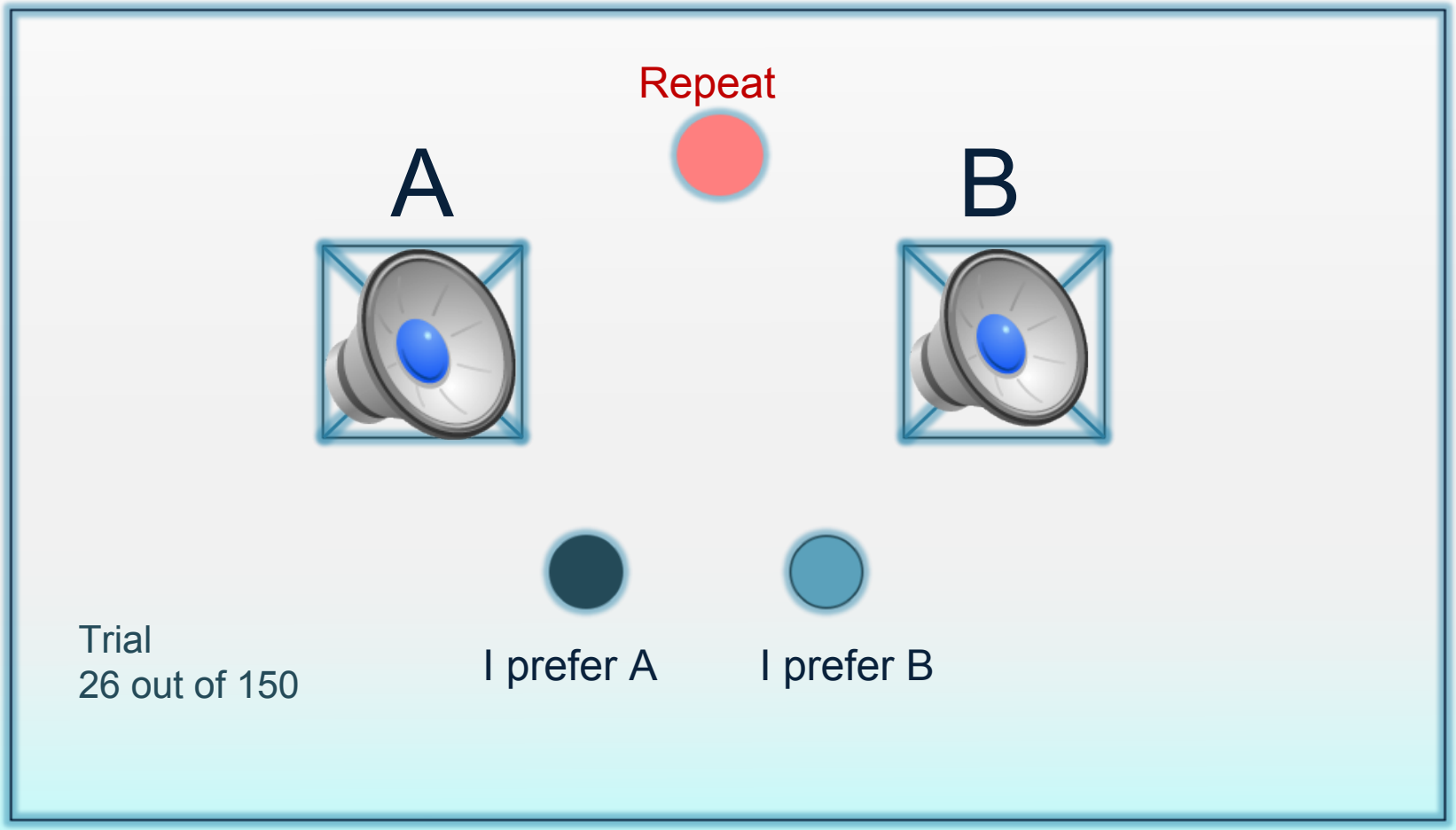
Procedure

- 150 trials, randomized
- All pairwise comparisons presented twice in counterbalanced order
- Double blind A/B comparison task
- Post-questionnaire on sound criteria used:
  - High frequency artifacts
  - Reverberation artifacts
  - Dynamic range
  - Stereo image
  - General distortion
  - Background noise
  - Transient artifacts

User interface



User interface

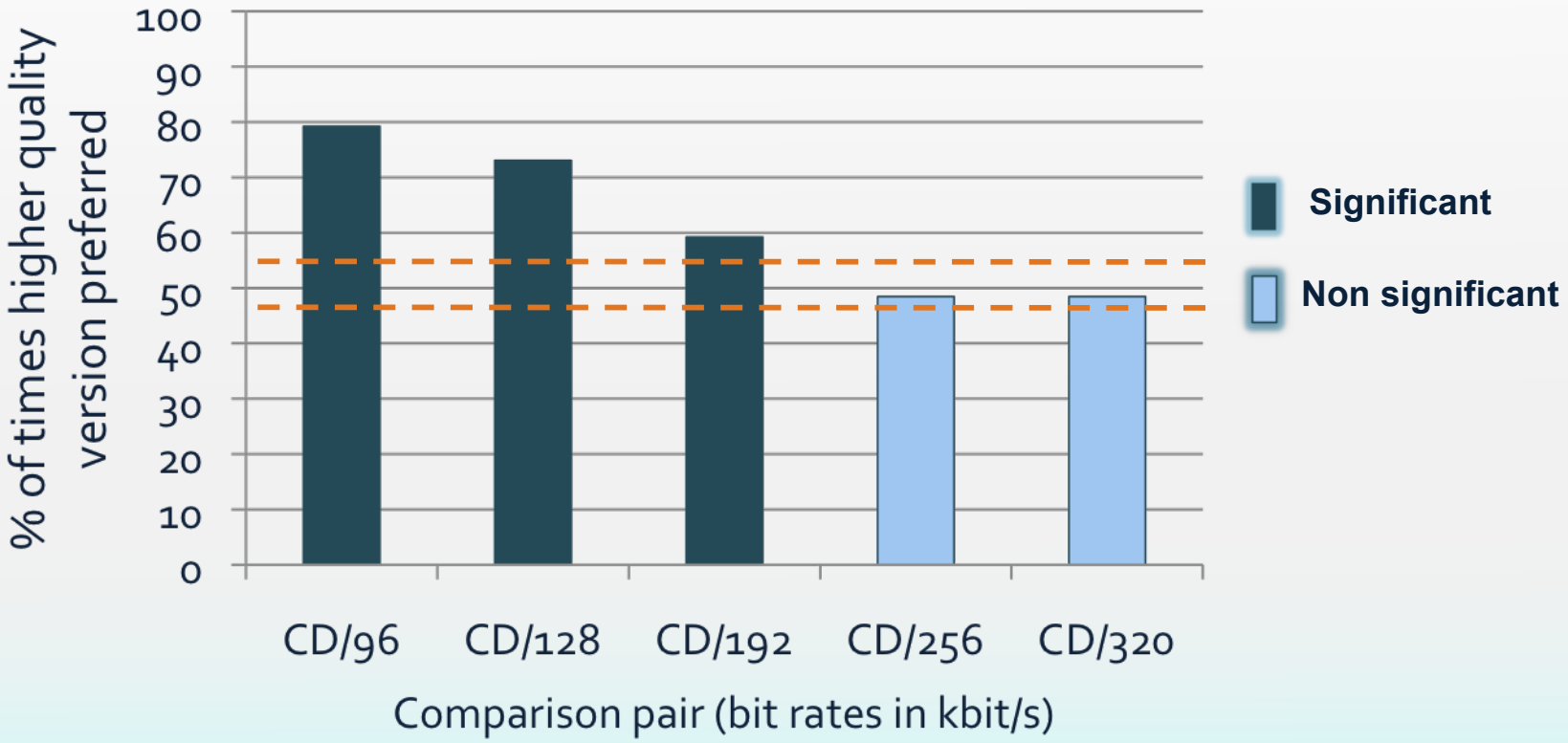


Critical Listening Lab

Listening conditions

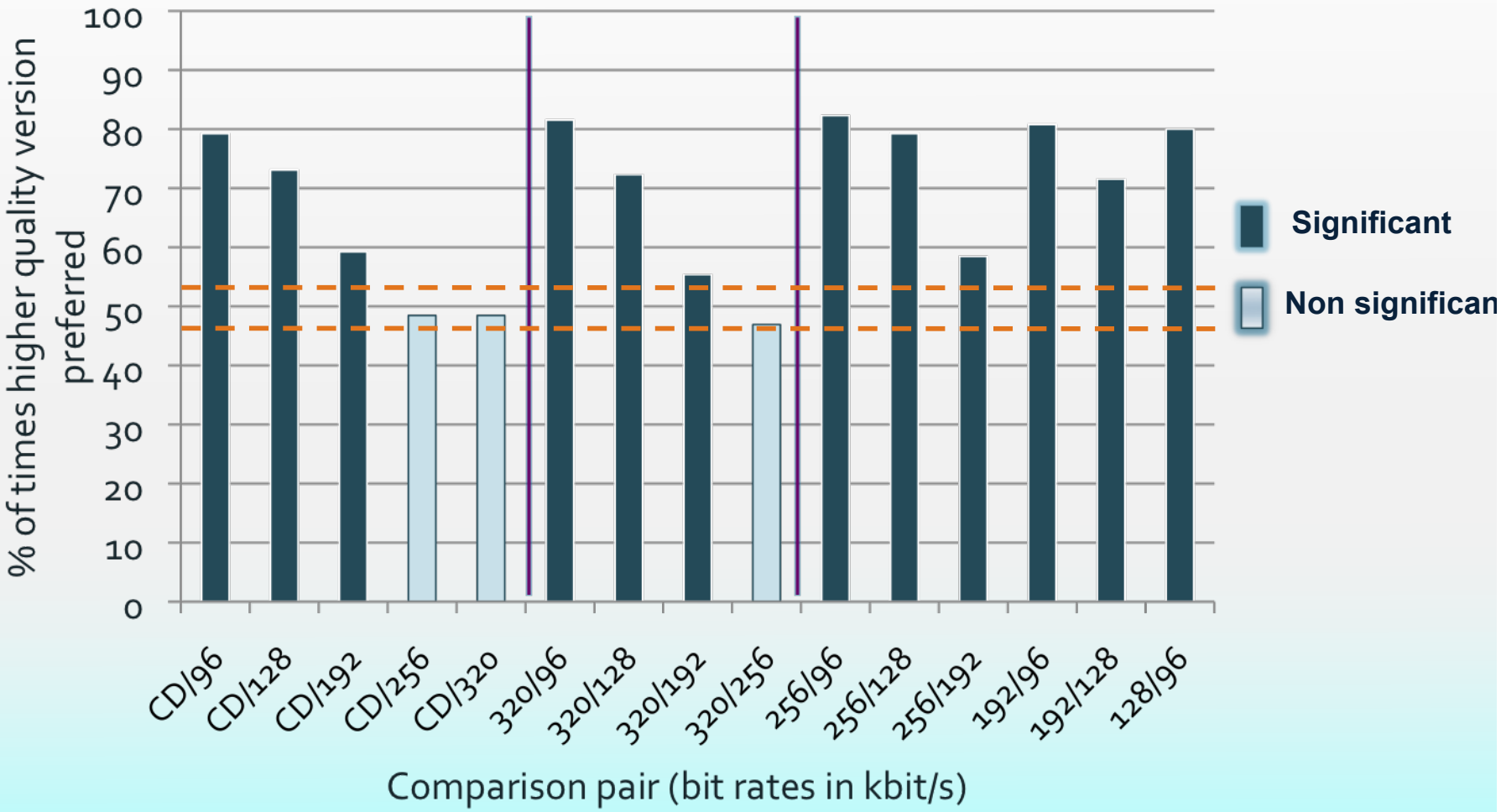
- ITU standard room: high quality controlled listening conditions
- Monitor controller Grace m906
- Stereo amplifier Classé CA-5200
- Loudspeakers B&W 902D

Overall preference results 1

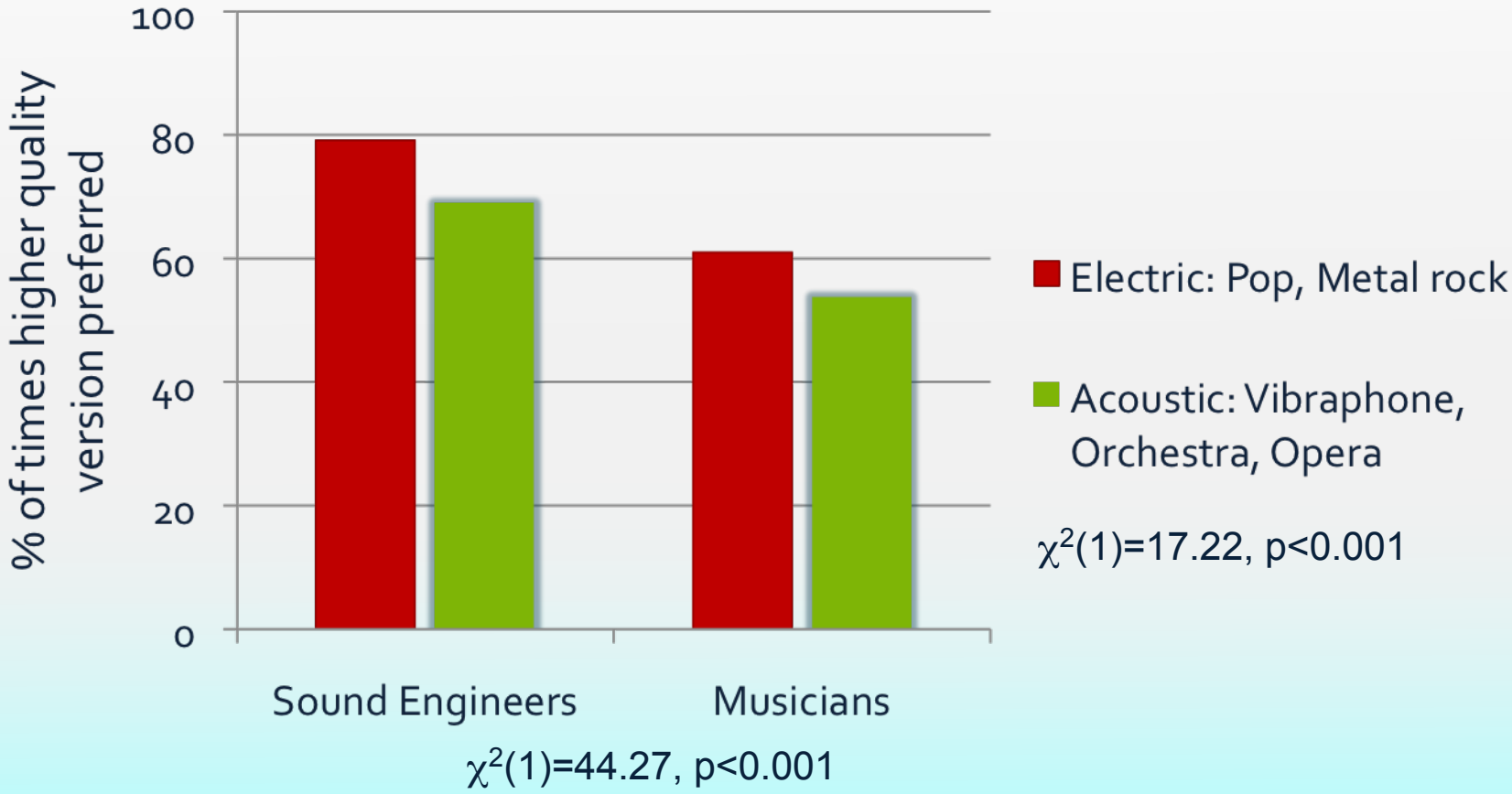


Non significant result at $p > .05$

Overall preference results 2

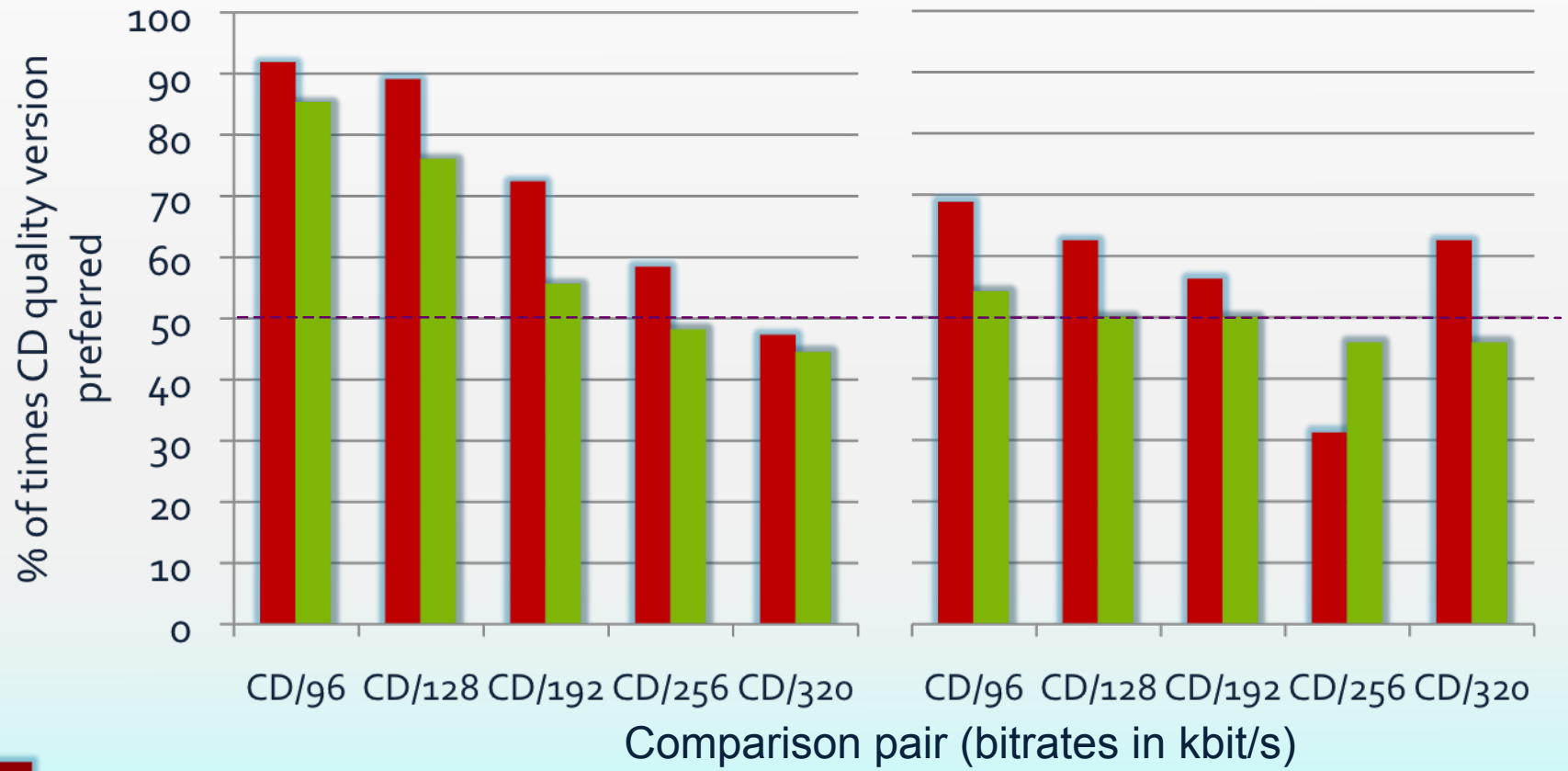


Effect on musical genre and expertise



Sound engineers

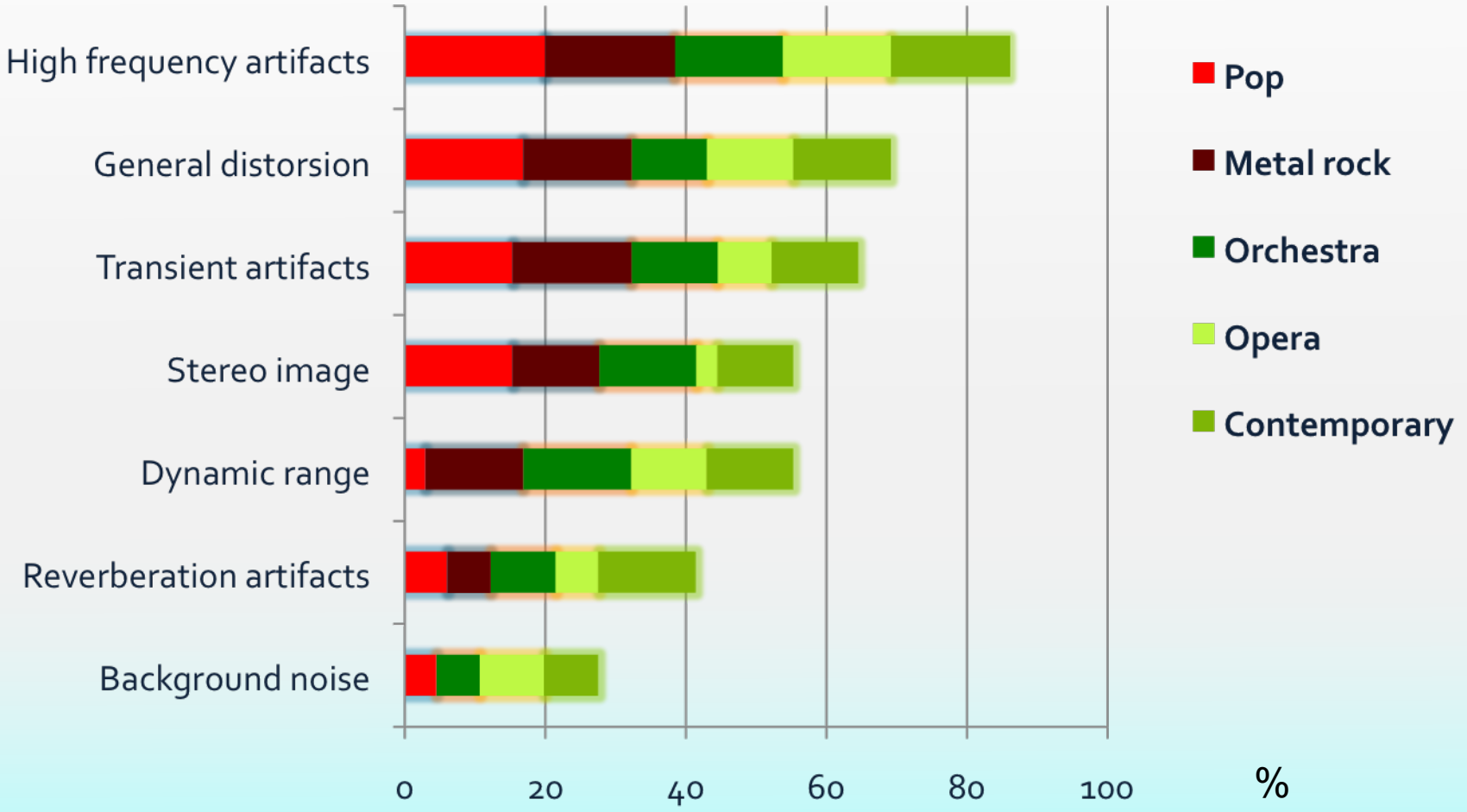
Musicians



Electric: Pop, Metal rock

Acoustic: Vibraphone, Orchestra, Opera

Sound criteria



Listeners' habits

- No correlation between listeners' habits and their results on the listening test
- No significant results between overall results and the results for familiar musical genre
- A professional drummer performed better with the pop excerpt than the 4 other clips

Conclusion

- Trained listeners can hear differences between CD quality and mp3 compression (96-192 kb/s) and prefer CD quality.
- Trained listeners can not discriminate between CD quality and mp3 compression (256-320 kb/s) while expert listeners could.
- Ability to discriminate depends on listeners' expertise and musical genre
- Artifacts can be verbalized and do not depend on musical genre

Future directions

- Change in mastering practice?
- Investigate the effect of listening conditions on performance

- Compare CD quality to High Resolution formats

Thanks a lot for listening

QUESTIONS?