Herbst, Jan-Peter

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“Heaviness” and the metal music guitar. Interactions between harmonic structure and sound from acoustic and perceptual perspectives.

BACKGROUND
In the music psychology discipline, “heaviness” is considered the determining criterion of the genre. On the ground of Berger’s (1999) work on death metal, heaviness has been associated with the sound of the electric guitar until today. Berger and Fales (2005) claimed the dominance of treble frequencies, high loudness and harmonic dissonance to constitute heaviness. Since it greatly affects these parameters, Berger and Fales concluded guitar distortion to be the primary acoustic phenomenon of heaviness in metal music. The list of research on heaviness and the distorted electric guitar is short. From a music theory perspective, metal music studies and the author’s experience when shifting from overdrive to a clean signal than overdrive to a distorted signal. The tests of between-subjects’ effects (Table 4) demonstrated a large effect size of between overdriven and distorted sounds that did between clean and overdriven sounds. The harmonically neutral power chord and the major chord differed only with a small effect. The ratings between all other chords differed much more. Overall, the difference between the chord ratings were greater when adding overdrive to a clean signal than when shifting from overdrive to distortion.

RESEARCH INTEREST AND METHOD
This study explored the interaction between the electric guitar’s sounds and chord structures acoustically and perceptually. Based on findings in music theory, metal music studies and the author’s experience as a guitarist, playing complex chords with overdriven and distorted sounds was expected to diminish sensory pleasantness. This sensation was assumed part of what constitutes the feeling of heaviness. Moreover, the reasons for this perception such as acoustic features and personal factors were of interest. The research followed a two-phase design with subsequent triangulation.

1. Acoustic experiment: Power-chords (fifth interval), major, minor and altered dominant chords were recorded with three guitars, five valve amplifiers and three sounds (clean, overdrive, distortion). The 270 samples were acquired with musical information retrieval technology (Lattixtol & Toivainen, 2007), following a design similar to Cziedik-Eysenberg, Knauf and Reuter’s (2016, 2017) work. The sensory pleasantness was operationalised with Terhardt’s (1984) and Aures’ (1985) model that considers both musical harmony and sensory pleasantness. Roughness, spectral fluctuation, sharpness, loudness and tonalness served as key parameters.

2. Listening experiment: Chords with the three different sounds taken from the acoustic experiment were rated by 171 respondents (mean age 22.06 years; SD = 3.3; 53% women) on a 10-point scale (1 = very unpleasant, 10 = very pleasant). Each chord was rated three times to reduce order effects. The mean ratings were transformed into scales for the sounds with excellent reliability (clean r = .92, overdrive and distortion r = .97) and explained variance (clean 67%, overdrive 82%, distortion 88%).

RESULTS
Acoustic experiment
As the different guitars and amplifiers did not significantly affect the five acoustic parameters, they were not taken into account further. This result and the statistical analyses (Table 1) indicate structure and sound to influence the features of the audio samples primarily. Regression analyses (Table 2) highlight the influence of sound on the chord ratings.

Listening experiment
The descriptive values (Table 3) and the Figure of the listeners’ ratings demonstrate the highest liking of major and power chords irrespective of their sound. Adding overdrive and distortion affected the rating of the least complex power chord least. A MANOVA with repeated measures revealed a large effect on sound, F(2) = 150.67, p < .001, η² = .47 and an even larger effect on structure, F(3) = 267.22, p < .001, η² = .61. Both variables interacted with a medium to large effect, F(6) = 53.38, p < .001, η² = .24.

TRIANGULATION
Spearman correlation indicated a close connection between the listeners’ ratings and most of the acoustic parameters (Table 6). In compliance with the psychoacoustic model (Terhardt, 1984; Aures 1985), all parameters but tonalness reduced the pleasantness of the chords. Roughness correlated with the listeners’ ratings least. In contrast, spectral flux as an alternative parameter for roughness had a much stronger correlation. Strong effects of spectral centroid and loudness were also confirmed to reduce pleasantness. Apart from the single parameters, Spearman correlation demonstrated a close connection between perceived pleasantness and structural complexity (r = -.63, p < .001) as well as between pleasantness and tonal quality (r = -.72, p < .001). This, more complex chords and greater distortion levels negatively affected the sensory pleasantness for many listeners.

Person-related factors hardly affected the ratings of the clean sound but did so in the cases of overdrive and distortion. Yet, the results of the overdriven and distorted sounds were similar. The univariate ANOVA (Table 5) of ratings of distorted sounds showed that music preference is most relevant, followed by the age and being an electric guitar player. Older participants showed a higher liking of distorted chords, r = .32, p < .001, as did men, r = .26, p < .01. Being a guitar player also affected the rating positively, r = .33, p < .001.