

Letter to the Editor

The Dark Side of the Moon: Music may reduce pain but white noise may increase it!

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Abstract

This *Letter to the Editor* reports findings from a randomized controlled cross-over trial, extending a previous study on the effects of music listening to reduce sensitivity to cold pain stimulation. Within this small replication, participants listened to music or white noise (compared to a silence condition) before nociceptive stimulation by the cold pressor task. Results show that in line with previous research pleasant music may increase pain threshold and tolerance compared to silence. Most interestingly we were able to show that annoying white noise may reduce pain threshold and tolerance. However, due to the small sample size these differences were not statistically significant. Clinical implications of these preliminary results linking pain sensitivity to environmental noise are discussed.

Keywords: Music, Noise, Pain, Cold Pressor Task

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Within a recent issue of *Music and Medicine*, Silvestrini et al. [1] reported findings from a well conducted experimental trial on the impact of pleasant and unpleasant classical music on experimental pain, compared to a silence condition and an auditory attention task. The authors found, that compared to the silence and the unpleasant music, pleasant music had a significant effect on assessed pain ratings and tolerance to cold pain stimulation by the cold pressor task (CPT). Moreover, the authors found that unpleasant music did not exacerbate pain experience in line with previous research [2]. However, we wondered if this would still be the case if subjects were presented with annoying noise and conducted a preliminary randomized cross-over controlled trial.

Healthy undergraduate students were recruited at the SRH University Heidelberg from June 2013 through August 2013. Upon arrival to the laboratory, participants provided written informed consent and completed several questionnaires. After inclusion in the study, subjects were randomly assigned to a music listening (ML) or white noise (WN) group. Experimental conditions consisted of either listening to 5 minutes of static white noise or pleasant classical music and a silence conditions before cold pain stimulation. The selection of musical pieces was based on the previous

mentioned study [1]. Participants could choose between 3 pieces of Western classical music: *Bach, Brandenburg Concertos no. 3, 1st movement*, *Mozart, Eine Kleine Nachtmusik Allegro* or *Bizet, Symphony in C Major, 4th movement*. Within their allocated groups, subjects were again randomized to either receive the experimental (ML or WN) or silence condition. The procedure was repeated with a washout time of 15 minutes between.

Cold pressor pain sensitivity was assessed by immersing the non-dominant hand up to the wrist in a 15.5 × 19.5 × 15.75 inches acrylic glass (2 cm thick) tank with circulating water (3 floor pumps Conrad Electronic GmbH AP-333, water flow: each 200 l/h) to prevent local warming. Water temperature was controlled as specified constantly with a chilling device (Resun CL 250) and water pump (Conrad Electronic GmbH Item no. 55 16 73, 1400 l/h) and measured with two digital thermometers (Electronics Tomorrow Ltd. 2120) at different spots (chiller inflow, chiller outflow). Minimum and maximum water temperature was recorded in °C for every thermometer and session and average to control for. Subjects were told to keep their hand open rather than closed in a fist while it was in the water. Before the immersion the subject was told to keep the hand in the water until cold pressor pain turned intolerable, with a cut off time of 4 minutes. The latencies to the first pain sensation (pain threshold, PTh) and then to the intolerable pain (pain tolerance, Pto) were measured with a stopwatch in seconds.

Twenty-seven participants completed the study. Twelve were allocated to the ML condition with 6 first listening to music. 15 got allocated to the WN condition with 7 first listening to the WN. Sample characteristics and dependent measures by group allocation are summarized in Table 1. Analysis of variance (ANOVA) revealed no statistically significant differences on PTh ($F(53)=0.876$, $p=0.423$, $\eta^2 = .181$) and Pto ($F(53)=0.515$, $p=0.601$, $\eta^2 = .141$) between the

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	Entire sample (silence)	Music	WN	<i>p</i> *
N (%)	27	12 (44.44)	15 (55.55)	
Female, <i>n</i> (%)	13 (48.15)	6 (50.00)	7 (46.66)	
Male, <i>n</i> (%)	14 (51.85)	6 (50.00)	8 (53.33)	
Age, mean years (SD)	25.26 (8.07)	25.00 (7.34)	25.47 (8.85)	0.885
Height, mean cm (SD)	172.46 (9.56)	173.09 (9.10)	172.00 (10.17)	0.780
Weight, mean kg (SD)	66.96 (14.04)	66.91 (17.81)	67.00 (11.19)	0.987
Right handed, <i>n</i> (%)	27 (100.00)	12 (100.00)	15 (100.00)	
Room temperature, mean °C (SD)	27.33 (3.22)	27.13 (3.16)	27.51 (3.38)	0.770
Water temperature, mean °C (SD)	6.17 (2.64)	5.55 (0.97)	6.69 (3.45)	0.282
Humidity, mean % (SD)	40.91 (8.02)	42.77 (4.15)	39.32 (10.15)	0.286
Pain threshold, mean sec (SD)	52.72 (80.34)	76.39 (99.43)	35.59 (57.95)	0.186
Pain tolerance, mean sec (SD)	69.07 (89.12)	88.18 (93.73)	52.97 (81.41)	0.319

Table 1: Sample characteristics and dependent measures;

*differences between the groups

conditions on the 0.05 level. Planned contrasts reveal marginal results of a linear trend on PTh such that pain threshold was the highest for ML, 2nd highest for silence, and the lowest for WN ($F(1,51)=1.749, p=0.19$). Planned contrasts for Pto revealed a similar pattern, although not significant ($F(1,48)=1.02, p=0.31$). Furthermore, no significant differences were observed comparing ML to silence (PTh: MD = 2.72, $p=0.933$; PTo: MD=7.09, $p=0.849$) and WN to silence (PTr: MD=-43.53, $p=0.159$; PTo: MD=-28.12, $p=0.436$), within the respective groups. Overall, non-significant results may be attributed to a small sample size, effect size, and power statistic (achieved power = .194 (Pth) & .137 (Pto)). Perhaps modifications to the allocation of treatment groups and treatment conditions will increase the effect size in the future, making significant results easier to yield with a moderate sample size.

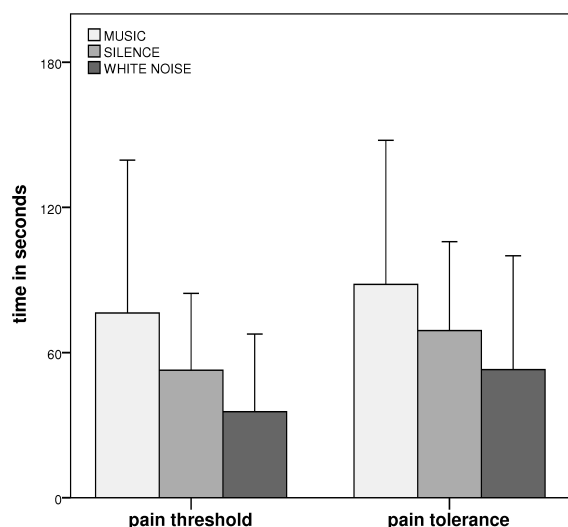


Figure 1: Pain threshold and pain tolerance by condition

While the present analysis failed to achieve the set level of significance, our trend analyses illustrate an emerging pattern in cold pain sensitivity due to the experimental condition. Subjects listening to music prior to nociceptive stimulation reported the greatest threshold and tolerance to cold pain, followed by subjects listening to nothing at all. Most interestingly we find, that subjects listening to white noise report lowest threshold and tolerance to cold pain stimulation (Figure 1). While this evidence comes from experimental research, it has several clinical implications. Noise is known to be an environmental stressor that may have adverse physiological and psychological effects. Particularly in a hospital environment [3], noise has the potential to increase complications in patients and impacts staff [4]. Future studies should try and replicate our preliminary findings within larger cohorts under natural conditions within the clinical setting, to investigate the impact of noise on pain perception and work on possible interventions to reduce noise within the clinical setting [5].

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