

EFFECTS OF

NOISE FREQUENCY

ON PERFORMANCE AND WELL-BEING

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Award: SHO2019 Best Paper Award, International Symposium on Occupational Safety and Hygiene 16th April 2019

Abstract

In a previous study we found that intermittent sounds, simulating alarm sounds, have a relevant effect on workers' performance and wellbeing. As the frequency of these sounds can influence subjects performance and well-being, a new study testing the effect of intermittent sound patterns with different frequency was carried out. Five noise conditions were simulated and tested through an experimental study with 16 undergraduate students. The influence of each condition on participants' attention and short-term memory was assessed with the serial recall and response inhibition tests. Discomfort, stress and annoyance were accessed using visual analog scales. No significant differences were found between the noise conditions in what regards to subjects performance. However, higher discomfort, stress and annoyance perceptions were found in condition with intermittent sounds at 3000 Hz. This study provided important insights about the influence of different noise frequencies on subject's performance and well-being.

Introduction

Ergonomics is concerned with the understanding of interactions among humans and other elements of a system. People in systems operate within a particular environment, which can have impact on their health, comfort and performance. Occupational noise is a health hazard present in several workplaces, with physiological impacts, including noise-induced hearing loss. However, occupational noise has been also related to negative effects on workers' well-being and performance. In fact, it is an important physical hazard pointed and studied in the field of cognitive ergonomics. It has been related to negative effects on stress, well-being and mental processes, such as perception, impaired attention and memory (Monteiro et al., 2018; Sousa et al., 2019; Golmohammadi et al., 2022).

The influence of occupational noise on workers' performance has been a matter of study, in particularly in the last years decade (see e.g., Khajenasiri et al., 2016; Nassiri et al., 2013; Monteiro et al., 2018). The features of occupational noise, in particular sound pressure levels, the type of noise and its frequency can be related to several non-physiological effects.

The study of the influence of occupational noise on workers' performance by this research team, has been started in 2015, were the sound pressure levels from a fast food restaurant were characterized and its effect on performance were analysed. We have investigated the effects of three noise conditions on attention and short-term memory, as well as on subjects' perceptions of discomfort, stress and annoyance. This first study ended in 2017, and the results were published in Monteiro et al. (2018a; 2018b). Since alarms frequency can have influence on the obtained results, and considering the importance to create alternative solutions to food establishments, where alarm signs are regular and several mistakes with the clients' requests observed, the influence of intermittent sound patterns with different frequency on performance and well-being were analysed in Sousa et al. (2019).

Methodology

A total of 16 undergraduate school student, 8 males and 8 females, were part of this study. The participants had a mean age of almost 22 years old (± 0.7 ; min=21; max=23).

In a laboratory context, five noise conditions were simulated and tested: Standard Condition (C0); Industrial noise with alert sounds at 500 Hz (C1); Industrial noise with alert sounds at 1000 Hz (C2); Industrial noise with at alert sounds at 2000 Hz (C3); Industrial noise with alert sounds at 3000 Hz (C4). The noise levels were fixed at 45 ± 0.3 dB(A) in C0, and in 68 ± 0.5 dB(A) in the other conditions.

The influence of noise on participants' attention and short-term memory was assessed with the serial recall and response inhibition tests. Discomfort, stress and annoyance were accessed using visual analog scales (100 mm in length; "Not at all..." to 100="Extremely...").

Results and discussion

No significant differences were observed between the different noise conditions for Serial Recall and Response Inhibition tests ($p > 0.05$). Similar results were obtained for the stimulus perception and perceptions of the interference of stimulus ($p > 0.05$). These results were not expected, in particularly considering results from previous studies. One possible explanation can be related to the small time of this experiment for each trial and also for the resting time. We want to continue this experiment, but these issues should be rethink, reducing also the arousal effect. The inclusion of tasks with different workloads can be also important in future experiments.

In what regards to discomfort, stress and annoyance results shows significant differences between the conditions under analysis for these variables ($p < 0.05$). Higher levels were found in condition C4 (Industrial noise with alert sounds at 3000 Hz). In what regards to discomfort, stress and annoyance results showed significant differences between the conditions under analysis for these variables ($p < 0.05$). Higher levels were found in condition C4 (Industrial noise with alert sounds at 3000 Hz). These results were expected, since high sounds frequencies are frequently related to higher discomfort, perception and sensitive (Ménard et al., 2008; Kumar et al., 2008). Results also denoted a relationship between the annoyance, stress, discomfort and interference, similar to what was previously identified in Monteiro et al. (2018a).

Conclusions

We start this research looking for alternate solutions for occupational noise in fast food restaurants, where alert sounds emitted by machinery are frequent. Despite no significant differences were found in subject's performance when they were exposed to intermittent sounds with different frequencies, it was identified an important impact of higher frequency stimulus on subject's discomfort, stress, and annoyance, which increasing fatigue with the time of exposure. Additional research about the influence of noise in workers' performance is needed, including field studies.

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Sousa, J., Monteiro, R., Tomé, D. & Rodrigues, M.A. (2019). Effects of Noise Frequency on Performance and Well-Being. In: Arezes P. et al. (eds). Occupational and Environmental Safety and Health. Studies in Systems, Decision and Control. pp 521-528. vol 202. Springer, Cham. ISBN: 978-3-030-14729-7. https://doi.org/10.1007/978-3-030-14730-3_56.

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