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# Assessment of total annoyance caused by combined industrial noises

A new study has assessed the annoyance caused by a combination of noises typically found on an industrial site. The results could help improve total noise annoyance prediction models. For example, it was found that 'broadband' noises, which consist of a wide range of frequencies, lead to more annoyance if they are combined with a specific additional set of low frequency noises, which can lead to an overall identical noise level.

People living in urban areas are exposed to noise from the surrounding community, such as from road, rail and air traffic or from near-by industries. Noise pollution influences health and wellbeing, and has been linked to heart problems and hearing loss, in addition to the annoyance felt when hearing unwanted sounds.

In this study, the researchers assessed the annoyance caused by typical industrial noises to determine the total noise annoyance of an industrial site. Permanent and steady noises coming from different sources were recorded on industrial sites and then played in various combinations to volunteers in a laboratory. The participants were asked to rate the total annoyance of the noise based on the instruction: 'Imagine yourself at home being exposed to this noise 24 hours a day. How much does this noise annoy you?'. The ability of different models to predict total annoyance was compared.

The study focused on the impact of steady and permanent noises consisting of 'broadband noise' (noise composed of a wide range of frequencies) and low frequency noise, often emitted by machinery and which can produce a sensation of vibration. Two combinations of these noises were considered:

1. Broadband noises coming from cooling towers combined with noises with some low-frequency content generated from air blowing equipment;
2. The same broadband noises combined with noises where the main component is at 100Hz (classified as low-frequency noise) produced by air-cooled transformers.

Generally, broadband noises were considered less annoying than low frequency noises. In addition, the total annoyance response of the participants for different noise combinations revealed that the different noises interact with each other. That means that some noises can partially mask other noises, leading to less annoyance.

In particular, broadband noises did not mask low frequency noise or 100Hz main-component noise as effectively as low frequency noise and 100Hz main-component noise masked broadband noise. The sound level of broadband noises would need to be higher than the low frequency noises to become the most annoying of the combined noises.

Broadband noises from air-cooling towers sound more 'natural', like flowing water, which is perceived to be less annoying than mechanical noises (although the combinations of noises were still considered annoying). As the sound level of noises in both types of combinations increased, so did the annoyance of the participants.

The varying inhibitory effects of different noise components in a mixture of noises, as found in this study, probably explained why some of the models commonly used to predict total annoyance were less accurate than others. The researchers suggest that using a new, mixed model can provide the best results. The mixed model incorporates the different contributions of the combined noises, in addition to the effects of the possible interaction between the noises, on total annoyance.

**Source:** Morel, J., Marquis-Favre, C., Viollon, S., Alayrac, M. (2012) A Laboratory Study on Total Noise Annoyance Due To Combined Industrial Noises. *Acta Acustica united with Acustica*. 98: 286-300.

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