



Why we wake up – the impact of traffic noise on sleep patterns

06 January 2011

Traffic noise is annoying, it causes stress and sickness — most people would agree to this. To combat the effects of the noise, we first need to understand how humans react to different types of noise. A research group from the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) Institute of Aerospace Medicine addressed this complex subject, disturbing the sleep of 72 people in the name of science.

The complete results of the study have been published in the January 2011 issue of the renowned medical journal SLEEP under the title 'Single and Combined Effects of Air, Road and Rail Traffic Noise on Sleep and Recuperation'.

Sleepless nights

Most complaints about traffic noise refer to the night hours. This is the time when the human body regenerates its energy and the mind is rested. If this regeneration process is interrupted by outside influences, one's ability to perform decreases the following day. This is an effect that everyone is familiar with.

Led by Mathias Basner, a team of doctors at DLR were prompted by this to focus on the influence of noise on sleeping patterns. As part of a study based at the sleep laboratory in Cologne, a total of 72 men and women aged between 18 and 71 years were exposed to recordings of traffic noise for 11 consecutive nights. The team's studies included the influence of noise on the waking response time, brain signals and heart rate. The researchers used nine different noise scenarios, which in turn contained several different sources of noise.

Traffic noise is never the same

A aircraft taking off makes a noise that is different from a freight train. A car, which is barely noticeable during the day, can wrench you out of your sleep at night. The effects of noise on the human body depend on the personal perception of the noise as well as the sensitivity to the disturbance.

Surveys on noise emissions show that the majority of those surveyed find aircraft noise the most disturbing, followed by noise from road and rail. To put these subjective perceptions to the test, the DLR scientists played back traffic noises from air, road and rail in a predetermined pattern in the volunteers' bedrooms – all at the same maximum sound level, ranging from 45 to 65 decibels. For one part of the night, the volunteers were also subjected to a mixture of different sources of noise. The findings were confirmed during noise-free nights.

During the morning after their nights in the laboratory, the volunteers underwent various concentration and memory tests. The trial participants themselves also rated the quality of their sleep and the level of disturbance.

Exciting results

The results of the study prove that, in addition to the maximum noise level, the rate at which the noise level increases has a significant influence on the degree of sleep disturbance. Sources of noise such as road or railway traffic, which occur suddenly and quickly reach the highest volume level, disturb the sleep structure considerably more than slowly increasing noises such as aircraft. The subjective perception of those tested did show, however, that aircraft noise was considered the biggest nuisance during the trial.

One explanation for this could be the duration of the noise. A healthy human wakes up about 20 times a night. In most cases the waking phase is too short for the person to register it or remember, especially if the noise in question has already gone by the time the person has woken up. As aircraft take longer to approach, reach their highest volume level overhead and then slowly disappear, the noise is still there after the sleeper has woken up and is consciously registered. There is also the disturbing influence these longer-lasting sources of noise have on going back to sleep.

The data assessment taken from the noise-related increase in heart rate showed that there was no getting used to the noise. Even after the volunteers had spent several nights in a row being subjected to the traffic noise, the individual noises still caused their hearts to beat faster. This key result supports the possible link between long-term exposure to noise pollution and the occurrence of heart and circulation problems.

Other results from the study show that the frequency of the traffic noise plays a key role in the disruption of sleep. Findings such as these can be used for further research into the optimisation of active and passive noise control methods.

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Recording traffic noise on a stretch of railway track



The traffic noises played back were recorded in residential areas under realistic conditions.

Credit: DLR (CC-BY 3.0).

Aircraft coming in to land



Surveys on noise emissions show that the majority of those surveyed find aircraft noise the most disturbing, followed by noise from road traffic and railways. To put these subjective perceptions to the test, DLR researchers played back traffic noises from the three areas – air, road and rail – in a precisely predetermined pattern in the volunteers' bedrooms.

Credit: DLR (CC-BY 3.0).

Trial participant during the sleep study



As part of a study based at the sleep laboratory in Cologne, a total of 72 men and women aged between 18 and 71 years were exposed to recordings of traffic noise for 11 consecutive nights. The team's studies included the influence of the noise on the waking response time, brain signals and heart rate.

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