

EFFECTS OF NOCTURNAL AIRCRAFT NOISE DAYTIME PERFORMANCE AFTER DISTURBANCE OF SLEEP BY AIRCRAFT NOISE

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Introduction Performance during activities at daytime depends on the quantity and quality of previous sleep. In several investigations it has been shown that sleep deprivation has a negative influence on reaction time, memory and coordination tasks. In order to study the effect of sleep disturbances that may be induced by aircraft noise during sleep, the Advisory Group for Aerospace Research and Development (AGARD) STRES Battery [3] was used to achieve objective data of possible performance decrements before and after sleep in noisy nights. These tests exhibited that partial sleep deprivation, lower oxygen concentration in the breathing air and alcohol consumption lead to comparable results with respect to performance impairment [2]. It has been hypothesized that the influence of aircraft noise on sleep would also result in changes of responses in these psycho-mental tests.

Methods 96 healthy volunteers spent 13 consecutive nights in our soundproof sleep facility, which is situated in the basement of the institute. 8 subjects were examined simultaneously. 16 subjects (control group) did not receive any aircraft noise during sleep, whereas the other 80 subjects got aircraft noise during nights 3 to 11. Aircraft noise differed with respect to intensity and frequency. Before subjects entered the facility, they intensively trained four tests of the AGARD test battery (at least 32 training sessions). During the study in the laboratory, every evening and morning the tests were performed. These four tests consisted of a “*single reaction time task* (SRT)” [1], two “*Memory Search Tasks*” (MST, of 4 and 6 letters, respectively) and an “*Unstable Tracking Task*” (UTT)” [3]. Within the SRT, counting (msec-) digits are randomly appearing on a monitor of a computer and the time is measured until the subject reacts to this event. During the MST, a single letter appears on the monitor and the subject has to decide as quickly as possible if this is one out of the set of letters (4 or 6) which the subject had to memorize at the beginning of the test. The time of response and its correctness are recorded. The UTT is used to examine the dexterity by means of testing hand eye coordination. The task within this test is to keep a bar, which is unsteadily moving on the monitor to the left or to the right, in the center of the monitor by steering a joystick. During this test the mean of deviation of the moving bar from the center of the monitor is recorded. All tests were performed in the same order at the same time in the morning (after getting up) and in the evening.

Results In the control group, after the first habituation night, a significant difference in all performance tests was not detected during days 2 to 11, if morning and evening tasks were compared to each other. In the group of 80 volunteers subjected to aircraft noise during nights 3 to 11, there was a small, but significant increase in response times of the SRT in the morning with number of the aircraft noise events ($p=0.015$). The standard deviation within these SRTs was also significantly increased with maximum level of the noise events ($p=0.04$). With respect to $L_{AS,eq}$, which was calculated for each night, the response times and their standard deviations also showed significant increases with the $L_{AS,eq}$ ($p=0.039$ and $p=0.030$). All other results of

performance tests of the morning sessions showed no significant correlation with aircraft noise during sleep. The results of the two MSTs (4 & 6 letters) in the morning showed a small, but not significant decrease of reaction times with increasing aircraft noise. All tests that were performed in the evening did not exhibit a significant correlation between test results and aircraft noise applied in the previous night.

Discussion Many results of the performance measurements did not show a significant change during morning sessions after nocturnal application of aircraft noise. Only the single reaction time task (SRT) did exhibit a small, but significant result. In the evening sessions, these small changes disappeared, probably because of other (day-time dependent) factors influencing performance. Whether the shallower sleep resulting from the influence of aircraft noise on deep sleep (see Basner et al.) may affect reaction times of this task, has to be evaluated further. It also has to be shown by adding data from the fourth laboratory study and the field investigations whether further (or other) alterations in performance can be detected.

Keywords: aircraft noise, mental power, AGARD-STRES-battery, tracking task, reaction time, vigilance

References

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