Dr. Barbara Griefahn

IV CONGRESSO INTERNAZIONALE
FOURTH INTERNATIONAL CONGRESS

Il rumore quale problema di salute pubblica

Noise as a Public Health Problem

Torino, 21-25 giugno 1983
Turin, June 21-25, 1983

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Martedì 21 giugno 1983 - ore 14,45
Tuesday, June 21, 1983 - 2,45 p.m.

Sessione Introduttiva
Introductory Session

Il rumore quale problema internazionale di salute pubblica
Noise as an International Public Health Problem

Chairman: J.V. Tobias (U.S.A)
CoChairman: H.v. Gierke (U.S.A.)

WHO PROGRAMME ON URBAN NOISE CONTROL

van den Eijk, J.

World Health Organization, Regional Office for Europe

SUMMARY

The World Health Organization has been active in the field of noise control for a long time. At its 9th Session in 1969, the Regional Committee approved a sub-programme on noise control as a component of the European Region long-term programme on pollution control. In 1971, a Working Group proceeded with the detailed planning of the Noise Control Programme. In September 1976, a Working Group on Noise Control in Buildings took place in Budapest, Hungary. In 1980, a booklet "Environmental Health Criteria No. 12 - Noise", was jointly published by the World Health Organization and the United Nations Environment Programme.

Finally, in 1982, the WHO Regional Office for Europe has planned an Urban Noise Control sub-programme as part of its programme on Environmental Health Aspects of Urban Development, to be developed during the 1984-89 period. The purpose of this paper is to describe the proposed programme, the content of which may, however, have to be reduced due to budgetary limitations.

COMMISSION OF THE EUROPEAN COMMUNITIES: ENVIRONMENT RESEARCH PROGRAMMES JOINT RESEARCH PROJECTS ON THE EFFECTS OF NOISES ON HUMAN BEINGS

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Commission of the European Communities
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SUMMARY

During the second (1976-1980) and the third (1981-1985) Environment Research Programmes of the Commission of the European Communities, two joint research projects were partially funded in close collaboration between many laboratories of the EEC, according to a common protocol:
1) effects of traffic noise on sleep in the home and on performance
2) effects of impulse noises on human beings.
The objectives and a brief description of these joint projects are given. The available results are presented separately in the teams sessions by the scientific leaders of participating laboratories.
Also a few research contracts are investigating other noise areas of interest for the CEC, like cardiovascular effects of noises, and combined effects of noises and vibrations.

PROTECTION OF WORKERS FROM THE RISKS OF OCCUPATIONAL EXPOSURE TO NOISE: ACTIVITIES OF THE COMMISSION OF THE EUROPEAN COMMUNITIES

van der Venne, M.

Directorate-General Employment, Social Affairs and Education, Commission of the European Communities, Luxembourg.

SUMMARY

As part of the Action Programme of the Communities on Safety and Health at Work the Commission has submitted a Proposal for a Council Directive on the protection of workers from the risks related to exposure to noise at work, aimed at controlling the risk to hearing and safety by limiting the acceptable exposure of the ear to noise. The principles upon which this proposal is based are outlined.

THE ACTION PROGRAMMES OF THE EUROPEAN COMMUNITIES ON THE ENVIRONMENT. - NOISE ABATEMENT POLICIES -

OLSEN Erik

COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General for the Environment, Consumer Protection and Nuclear Safety

SUMMARY

The paper outlines the action programmes of the European Communities on the environment and the measures taken at different level to combat noise. It gives a survey of the policies pursued by the Commision of the European Communities to attain the objectives of the programmes.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. TC43 ACTIVITIES RELATED TO NOISE AS A PUBLIC HEALTH PROBLEM.

Ingerslev, Fritz

The Acoustics Laboratory, Technical University,
Lyngby Denmark

SUMMARY

The International Organization for Standardization - ISO - is a non-profit organization whose aim is 'to promote the development of standards in the world.
International Noise Standards can be divided into the following six main categories:

Category 1. Basic Standards on description and measurement of environmental and occupational noise plus evaluation of its effects on human beings.

Category 2. Basic Standards describing various methods for measurement of noise emitted by machines and equipment.

Category 3. Specific 'Noise Test Codes' for various types of machines and equipment.

Category 4. Standards for measurement of noise emitted by road and rail vehicles, vessels, aircraft and other means of transport.

Category 5. Standards on measurement of sound insulation and sound absorption.

Catetory 6. Various other noise standards.

The problem of noise from the point of view of the legislator

Carlo VETERE M.D.

Ministry of Health- Rome

SUMMARY

Penal and civil code do not allow to fix a maximum allowable level of noise produced by different sources,while Traffic Regulations deal with the noise produced by engine and particularly by sound signals.According to Health Regulations some limits have fixed for background noise from industries;other criteria rule in a general ways the noise abatement in hospitals and buildings financed by Public Funds. In working places the most part of internatio= nal regulations have been introduced within the collective agreements between Trade Unions and Owners. The Health Reform point out the aim of noise abatement giving to the Governement the possibility to establish with administrati= ve measures. After a long consensus meetings a general Bill for noise abatement will be presented,while a Decree of the President of Council (Premier) shall deal with noise in living premises and in the environoment,working places protection being ruled as above mentioned.
The present political crisis will delay the approuval of these measures.

NOISE- INDUCED HEARING LOSS AND SOCIAL INSURANCE PROTECTION: EXPERIENCES AND PERSPECTIVES

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SUMMARY

Noise became the spreadest risk factor and the one which the largest workers' number is exposed. In the last years, then, the noise-induced hearing loss (NIHL) seems to be the most frequently diagnosed occupational disease and the one responsible for the highest number of life-long pensions due to permanent disability (more than 46.000 during the 1977-1978 period and 12.233 in 1979).

After the minimum compensation lowering (from 21% to 11% in 1977), and whereas, during the assessment, we employ a method that privilege the little threshold shifts, it's possible to settle a life-long pension to workers with a pure tone audiometry in to the standard lower limits and who aren't yet qualifiable as having a hearing loss: an uniform and more equitable metodology is absolutely necessary.

Particular characteristics of NIHL and technological development point out forensic and insurance medicine's problems, which are remembered.

"De iure condendo" perspectives to avoid protection lacks are suggested: certainly technical and medical prevention allows a better protection.

Mercoledì 22 giugno 1983 - ore 9,00
Wednesday, June 22, 1983 - 9,00 a.m.

Gruppo di Studio n. 1
Team No. 1

L'ipoacusia professionale
Noise-Induced Hearing Loss

Chairman: W.D. Ward (U.S.A)
CoChairman: H.-G. Dieroff (East Germany)

Invited Papers

MEASUREMENT AND RATING OF IMPULSE NOISE IN RELATION TO NOISE-INDUCED HEARING LOSS

Passchier-Vermeer, W.

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TNO Institute for Environmental Hygiene, Delft, the Netherlands

SUMMARY

An analysis is given of papers concerning noise-induced hearing loss from impulse noise exposure. It is concluded that insufficient data are available at the moment to give a definite statement whether impulse noise exposure is more damaging to hearing than exposure to constant or fluctuating noise.

A method of rating and measuring impulse noise exposure is proposed.

CONCLUSIONS FROM ANIMAL EXPERIMENTS ON THE EFFECT OF STEADY-STATE AND IMPULSE NOISE

Nilsson,P.[1],Dunn,D.[1],Erlandsson,B.[2],Grenner,J.[1],Håkanson,H.[2], Ivarsson,A[1] and Wersäll,J[3]

From the [1]Departments of Otolaryngology and of Experimental Research, Malmö General Hospital, Malmö and the [2]Department of Physics,Lund, University of Lund and the [3]Department of Otolaryngology, Karolinska Sjukhuset, Stockholm, Sweden

SUMMARY

While the effects of exposures to continuous noise have been known for many years, the injurious effects of impulse noise have been studied closly only during the last decades, after the technical developments made it possible to analyze the impulse sounds. The L -formula was created years ago to satisfy the need for a simple measure of noise for damage risk criteria purposes. Recently,impulse noise been proposed to be included in in noise evaluation with the new ISO/DIS 1999 document. However, when using the L -formula there might be a tendency to overlook the injurious effects of the different parameters of noise. For ethical reasons these effects can hardly be investigated in man. We have exposed groups of guinea pigs to investigate the patterns of damage caused by changes in sound intensity, exposure duration or in frequency. As a result of the exposures we have found patterns of damage that are both common to and distinguishing between the different kinds of exposures. These patterns are mixed in such a way that under limited conditions the so called "Equal-energy rule" seems to be valid. These basic patterns are important because taking them into account could result in new procedures being used in hearing conservation programs.

HEARING LOSS IN WEAVERS AND DROP-FORGE HAMMERMEN: COMPARATIVE STUDY ON THE EFFECTS OF STEADY-STATE AND IMPULSE NOISE

Sułkowski, W.J., Kowalska, S. and Lipowczan, A.

Audiology Department, Institute of Occupational Medicine, Łódź, Poland

SUMMARY

Two groups of subjects matched for sex, age and years of work experience, namely 112 weavers and 64 forge hammermen exposed to typical continuous steady-state and impulse noise respectively were carefully examined. 169 noise free workers of administrative staff served as controls.

Detailed noise assessment revealed nearly the same equivalent sound levels in both plants i.e. Leq = 101.8 dB-A in the cotton weaving mill and Leq = 100.4 dB-A in the drop forge; the following characteristics of impulses in the latter were found: peak pressure level 110.7 dB, rise time 0.3 ms, impulse duration 30 ms, repetition rate per second 3.64, background noise level 92.1 dB-A, total number of impulses per day 80 000.

The comparison of mean hearing thresholds have pointed out that hearing loss is significantly greater in the forge hammermen, although its time course in both groups is similar i.e. maximum shift occurs after 10-15 years of noise exposure and asymptote is reached by 20 years or so. There is however different audiometric configuration of mean hearing loss with the largest dip at 4 kHz in weavers exposed to steady-state noise versus the dip centered at 6 kHz in forge hammermen exposed to impulse noise. It seems therefore that the both classes of noise - at least at equivalent sound level of 100 dB-A -induce somewhat another effect and worse damage due to impulse exposure is observed.

ACOUSTIC REFLEX AMPLITUDE IN RESPONSE TO CONTINUOUS NOISE AND IMPULSE NOISES WITH THE SAME ENERGY CONTENT.

Rossi,G.

Department of Audiology, University of Turin, Turin, Italy.

SUMMARY

Decreases in the amplitude of the reflex contraction of the stapedius after exposure to the same amount of fatiguing acoustic energy administered in diffferent ways (continuous white noise; bursts of white noise at 0.2/sec, 0.5/sec, 1/sec, 2/sec, 3/sec, and 4/sec) were assessed as percentages of the start value after 5', 10', and 15' in a study conducted on 10 subjects with normal hearing aged 20-25 yr.

The results suggested that the mean decrease in response to protracted noise with the same energy content depended on the administration modality. The fatiguing effect of noise, in other words, is more dependent on its time of administration than its energy content. Pulsed noises may thus be much less fatiguing than a continuous noise with the same spectrum and energy content.

If this fatiguing effect were to be translated into reduction of the protection of Corti's organ, in other words, a reduction in stapedius contraction amplitude resulting in a greater amount of acoustic energy reaching the inner ear, it would be obvious that hearing damage ascribable to noise is not a function of the amount of environmental acoustic energy, but of the amount that gets past the middle ear and reaches the inner ear. Given the same amount of ambient energy, therefore, the amount reaching the inner ear will vary in accordance with the time pattern with which such energy is delivered to the ear.

THE VALUE OF THE HIGH-FREQUENCY AUDIOMETRY IN NOISE INDUCED HEARING LOSS COMPAIRED WITH THE CONVENTIONAL AUDIOGRAM.

Dieroff, H.G.

Department of Audiology, ENT-Clinic, University Jena, DDR.

SUMMARY

After refering to the importance of testing the high-frequency hearing and the difficulties in sound coupling the progress in evaluating the damage of the whole cochlea is described. For the recognition and diagnosis of noise induced hearing loss high-frequency audiometry shows considerable advantages and is recommended for early diagnosis and prognosis of noise-induced hearing loss.

EFFECTS OF NOISE AND SOCIOECONOMIC FACTORS ON HEARING IMPAIRMENT

Davis, A.C.

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Nottingham University, Nottingham NG7 2RD, UK.

SUMMARY

Because of the high collinearity between noise immission ratings and age, sex and socioeconomic group, and because of the low population prevalence of substantial noise immission ratings, it has so far proved to be very difficult to associate a noise history with increased risk of measured hearing impairment in the general population. We do not of course deny that high noise levels can cause hearing loss and should be controlled. Rather our population studies suggest that further noise control and hearing conservation measures, might make only a small impact on general population prevalences of hearing impairment. More generally, our studies provide a necessary framework for assessing the influence of noise or any other noxious factor on hearing. Age and sex should be taken into account as covariates, also socioeconomic group and housing type. Perhaps most importantly whether there is any history or presence of tinnitus should be included as a stratification variable in noise studies, as significant noise effects are more readily shown for tinnitus than for hearing levels.

PRECISION AUDIOMETRY AND THE EFFECTIVENESS OF HEARING CONSERVATION PROGRAMS.

Erlandsson, B.[1], Håkanson, H.[1], Ivarsson, A.[2] and Nilsson, P.[2]

[1] Department of Physics, University of Lund, S-223 62 Lund, Sweden.

[2] Department of Otolaryngology, University of Lund, Malmö General Hospital, S-214 01 Malmö, Sweden.

SUMMARY

Very few investigations have been performed into the effectiveness of hearing conservation programs especially if a reduction in the deterioration in the hearing threshold levels is taken as a measure of the effectiveness.

Our starting point has been to investigate the accuracy with which hearing thresholds can be measured in routine field audiometry and then to improve this accuracy. Statistical analysis of the data has made it possible to make predictions for the trend of these data.

Serial audiometry was performed on two groups of shipyard workers each year for seven years. A sweep-frequency Békésy audiometer was used, and during the last three years the cushions attached to the earphones were replaced by ear specula. This caused a reduction in the uncertainties in the hearing threshold levels of about 33%.

The results show that a hearing conservation program that was put into operation 2-3 years after the start of the investigation, and which was followed up after a further year with individual information for those who showed a hearing deterioration significantly greater than presbyacusis, was effective.

Conclusions regarding the effectiveness of hearing conservation programs can thus be drawn through observations fo the change in ΔHTL (the yearly rate of change in hearing threshold) at such low level that they only to a minor extent affect the hearing situation of the person taking part in the program.

EARLY DETECTION OF HEARING DAMAGE BY HIGH-TONE AUDIOMETRY.

Ribári, O. and Kiss, J.G.

ENT Clinic, University Medical School, Szeged, Hungary

SUMMARY

The authors constructed a high-tone audiometric system. This system was used for the examination of high-tone hearing of subjects with normal hearing as well as of workers in noisy working places and also of patients who received aminoglycosides. They found that with the proper employment of high-tone audiometry hearing damage by excessive noise and hearing loss caused by ototoxic drugs may be detected earlier.

ON PREDICTION OF PTS BY MEANS OF PSYCHOACOUSTIC INVESTIGATIONS AS WELL AS REGISTRATION OF COCHLEAR EMISSIONS.

Fritze, W.

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SUMMARY

In a predictive study first evidence was obtained showing that a previously unknown effect seen in TTS experiments can be used for predicting chronic noise-induced hearing loss. This effect is a transient dip at 4 kHz which consistently occurs at this site irrespective of the exposure frequency. It does not correlate with the well-known first dip which reaches its maximum 1/2 to 1 octave above the exposure frequency. An extensive study designed to shed light on the predictive potential of this dip is currently conducted in an Austrian steel mill (VOEST, Linz).

In a second section, the capacity of cochlear emissions for predicting chronic noise-induced hearing loss is reviewed. Recent evidence suggests both the spontaneous and the evoked acoustic outputs of the cochlea to reflect cochlear lesions. Their occurence shows pronounced intersubject variability. This implies that currently known cochlear outputs are not very likely to be used rountinely for predicting noise-induced hearing loss. More sensitive microphones might, however, help to detect emissions originating from intact cochlear sites in the normal hearing process. Whether these will be suited for predicting PTS will have to be seen.

BIOCHEMICAL MECHANISMS AFFECTING SUSCEPTIBILITY TO NOISE-INDUCED HEARING LOSS

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Institut für Wasser-, Boden- und Lufthygiene des Bundesgesundheitsamtes Berlin

Institut für Molekularbiologie und Biochemie, Freie Universität Berlin

SUMMARY

Two important conditions for increased susceptibility to NIHL are

1) Mg deficiency and
2) increased catecholamine concentrations.

These two conditions may act simultaneously and thus have an additive effect on susceptibility to NIHL.
Beyond this, these two conditions were found to be interrelated (Fig. 6) and thus amplifying each other through a feedback mechanism (Ising et al., 1981).
Since the basic mechanisms of sound transduction in the inner ear are related to membrane permeability and energy-dependent transport mechanisms both of which are influenced by Mg and catecholamines, the long-term interaction of Mg decrease and increased catecholamine concentrations are likely to increase the risk for human NIHL.

NEW PROCEDURES FOR THE EVALUATION OF HEARING PROTECTORS

Humes, L.E. and Ahlstrom, J.B.

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Vanderbilt University School of Medicine
Nashville, Tennessee USA

SUMMARY

Four experimental procedures were used to assess the attenuation provided by hearing protectors at high noise levels. Results for 10 protectors (5 muffs, 5 plugs) were compared to those obtained with the standard real-ear attenuation-at-threshold procedure. The four experimental procedures were: (1) a magnitude-estimation paradigm; (2) a reaction-time procedure; (3) a real-ear miniature-microphone method; and (4) a masked bone-conduction procedure. Results indicated that attenuation was linear throughout the range of 1/3-octave noise levels investigated (approximately 50 through 90 dB SPL).

HEARING PROTECTORS - SELECTION AND EFFICIENCY

Pfeiffer, B.H.

Department Noise and Vibration, Occupational Safety Institute of Industrial Injuries Insurance Institutes, Sankt Augustin, Germany

SUMMARY

Hearing protectors in hearing conservation programmes are not as effective as they were expected to be. This may be explained by the low wearing frequency and by the reduced daily wearing time. The total energy principle shows, that the effective sound attenuation is reduced by short wearing pauses; on the other hand even a low effective sound attenuation reduces the damage risk. Wearing comfort becomes an important criteria testing hearing protectors. Testing results according to DIN 32 760 are presented, showing that the non-acoustical properties are as important as the sound attenuation at least. The selection of suitable hearing protectors for the noise situation at the working place and for the working environment can provable increase the wearing frequency and the daily wearing time. A selection strategy is presented, including a simple selection method for the sound attenuation with respect to the noise spectra, that can easily be put into practice.

APPLICATION OF TTS MEASUREMENTS FOR THE EVALUATION OF NOISE HAZARD A FIELD STUDY.

Lipowczan,A. - Sułkowski,W. - Tengler,M.

Technical Acoustics Department, Central Mining Institute
Katowice,Poland.

SUMMARY

Long-term investigations of noise in coal mines reveald the problem of taking measurements at test stands with a great hazard of methane explosion.In order to facilitate the evaluation of noise hazard at the work place in coal mines attempts have been made to apply TTS measurements. Measurements of TTS within 3 to 5 minutes from cessation of noise exposure,which were carried out in full-scale industrial conditions,have made it is possible to evaluate the equivalent sound level in which the tested persons had been abiding.In industrial condition audiometric measurements should rather be carried out at lower frequencies (500 Hz ,1000 Hz) ,because then random errors can be avoided

SERIAL CHANGES IN AUDITORY THRESHOLDS FROM 8 TO 18 YEARS IN RELATION TO ENVIRONMENTAL NOISE EXPOSURE

Roche, A. F., Mukherjee, D., Siervogel, R. M., and Chumlea, Wm. C.

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SUMMARY

The findings presented are from analyses of data, recorded each six months, for 270 children aged 6 to 18 years. Serial threshold data may be affected by familiarity with the test environment, knowledge of test strategies, and changes in motivation. Also, noise exposure may alter if the study leads to increased awareness that noise might reduce hearing sensitivity. Regressions were performed with thresholds as dependent variables; the independent variables were examination order and corresponding age. After removing age effects, the mean slopes of thresholds against examination order have significant negative values, indicating thresholds decrease with examination order. The cumulative examination effects for eight serial examinations were about 3 dB, at 0.5, 1, and 2 kHz and about 5 dB at 4 and 6 kHz.

Sex-, ear-, and frequency-specific linear regressions of thresholds, adjusted for examination effects, on age, were calculated for each participant with four or more serial thresholds. Intercepts and slopes from these regressions were interpreted in relation to long-term threshold shifts. There were no significant differences between mean intercepts among frequencies in the boys but in the girls those for 0.5, 4, and 6 kHz were significantly higher than those for 1 and 2 kHz. Most mean slopes (db/year) were negative indicating hearing sensitivity improved with age, but they differed significantly from zero only in the girls. The largest absolute residual from the regression line for each child was regarded as a short-term threshold shift. The means of these residuals were larger at 6 kHz than at the other test frequencies. The shifts tended to decrease with age in each sex. They had a significant tendency to occur at the same age for both ears and all frequencies tested.

Noise exposure. Analyses were made of 151 sets of observations from children whose noise exposure levels were measured with Metrosonics Metrologgers for 24-hour periods. Each participant kept a diary of timed activities during noise recording. An ($L_{eq(t)}$) was calculated for each activity category. This provided a measure of the noise associated with a specific activity averaged over individuals without respect to duration. Also ($L_{eq(8)}$) was calculated to represent the noise level that, given over an 8-hour period, would have the same sound energy as that to which the children were exposed. Girls had lower means than boys for almost every activity, but the differences were significant only for walking to and from school, school normal classes, home radio/T.V., and sleep.

In boys, lawnmowers/combustion engines, live music, school bus, and school assembly/recess were major noise sources. These, except for lawnmowers/combustion engines, were major sources for girls. Each of these sources had an ($L_{eq(t)}$) > 80 dB, and the average duration was from 0.5 to 2.1 hours per day in those exposed. These noise exposure data tended to decrease with age, except for live music. The ($L_{eq(8)}$) values were converted into kilo Pascal squared persons (Kpa^2) and multiplied by the number of boys and girls reporting exposure. School assembly/recess was the most important noise source for boys and live music was the most important source for girls.

ON THE GROWTH AND DECAY OF ASYMPTOTIC THRESHOLD SHIFT IN HUMAN SUBJECTS.

Shaw, E.A.G.

Division of Physics, National Research Council of Canada, Ottawa, Canada

SUMMARY

This work brings together ten sets of data from seven experimental studies with human subjects in which the temporary shifts in hearing threshold (TTS) at 4 kHz were measured during exposure to moderate levels of steady noise for periods up to 48 hours and post-exposure for periods up to 72 hours. The synthesis shows that the growth of TTS due to pink noise at any given level L_A is virtually indistinguishable from that due to 4 kHz octave-band noise having an SPL 5 dB lower than L_A. Smooth curves fitting the distributions of data are nearly exponential in form. Asymptotic threshold shift (ATS) is approached at 8 hours and is attained within 16 hours. The average ATS at 4 kHz appears to double with each 5 dB increase in level over the range 70-90 dBA. Its magnitude is 11 dB for pink noise at 85 dBA and 4 kHz OB noise at 80 dB SPL. During recovery, the average TTS falls rapidly from the asymptotic value to a plateau which is attained approximately 0.5 hours post-exposure and maintained until approximately 4 hours. Smooth curves fitted to the full complement of data show that approximately 25% of the recovery from ATS occurs within 10 minutes, nearly 50% within one hour, 75% within 12 hours and 90% within 24 hours. Close scrutiny of the data indicates that the level of the recovery plateau may be substantially higher for 48-hour exposures to pink noise than for 24-hour exposures (perhaps 70% of ATS compared with 35%). This is consistent with a conclusion reached by the authors of the 48-hour experiments. Measurements of TTS during recovery from asymptotic ATS are thought to shed light on the potential long-term effects of occupational noise exposures of exceptional duration as well as chronic exposures to environmental noise.

Poster Session

THE IMPULSE NOISE EXPOSURE AND THE EFFECT OF PROTECTORS IN ARMY

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SUMMARY

Among 351 military conscripts, many hearing deteriorations occurred during the 8 months' period of military service (in 14.8 %), and those serving 11 months developed relatively more. The most important source of noise was the assault rifle; average 200-450 rounds/man during an 8-month period. The peak values of all weapons exceeded 130-150 dB. Clearly, more shifts were confirmed in the left ear.

The risk of hearing damage can be diminished either by technical, structural preventive methods or by the use of individual hearing protectors.

The impulse noise reduction of the tested ear cups were 26-37 dB(A) as the difference of Lpeak-values and 24-36 dB without A-filter. The greater the volume of the cup the better the reduction was (3-5 dB). There was no substantial difference between the reduction for continuous and for impulse noise.

Study of professional hypacusia in relation to closed environments

Dott. Piero Battini, Dr.ssa Rossella Francalanci, Dr.ssa Stefania Caporiccio

S.M.P. - U.S.L. 10/A, Firenze

SUMMARY

The Authors would call attention to the methods used for determining the level of environmental noise and to the necessity of arriving at a universally accepted Recommendation. Moreover the Authors, on the basis of the results of the Robin Round Test, question the usage of cutting down noise with the A weighting filter, and, having taken into consideration the studies conducted by other researchers, suggest substituting it with another, more appropriate filter capable of better protecting those workers exposed to the risk of professional hypacusia, which manifests itself principally as a loss of hearing at 4KHz.

A STATISTICAL EVALUATION ABOUT OCCUPATIONAL HEARING LOSS IN IRON-MECHANICHAL WORKMEN OF A VERONESE INDUSTRY.

Gaceffo G.

Sanitary District n°1, S.S.L.U. 25, Verona, Italy.

SUMMARY

In this short work are considered, only from a statistical point of view, the auditory apparatus damages occurring in iron workers of a foundry division, also in relation to noise exposure periods.

THE EVALUATION OF DAMAGE IN NOISE-INDUCED HIGH FREQUENCY HEARING LOSS

Caporale, R. and Carluccio, F.

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SUMMARY

Sensorineural hearing loss due to chronic acoustic trauma with a raised threshold at 4 KHz, does not influence the discrimination score for PB vocal material. This has, to date, led us to believe that this sort of hearing loss does not have a negative influence on the general working capacity of each subject. A group of workers, who presented a sensorineural hearing loss at 4 KHz due to chronic acoustic trauma underwent sensitized speech audiometry (accelerated and frequency filtered sentences). Using these tests all subjects showed a significant SRT shift. Since such results prove that a high frequency hearing loss can interfere with working capacity, the Authors came to the conclusion that reference to tables that deny the importance of hearing loss at 4 KHz, is not adequate for a correct evaluation of generic working capacity.

STATISTICAL ANALYSIS OF NOISE-INDUCED HEARING LOSS IN INDUSTRIAL WORKERS

Caporale,R.- Viora,G.

ENT Department, Rome University 'La Sapienza'

SUMMARY

From 1977-1981, 57.303 cases of professional deafness were reported in Italy. They account for 27% of all professional diseases reported during the same time span.

The Authors analysed audiometric data relative to 1000 industrial workers affected by professional hearing loss. Noise-induced hearing loss is found to a greater degree in workers from 40-49 years of age who have been in active service for 6-15 years. 60.5% of the subjects taken into consideration show damage (refered to generic working capacity) inferior to 11% and therefore are not due for compensation benefit.

A POSSIBLE ASSESSMENT OF OCCUPATIONAL NOISE EXPOSURE

Cocchi, A.

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SUMMARY

Until now all research carried out to individuate a technique to measure noise, which allow us to evaluate, in the best way possible, if a noise may be dangerous, and if so, to what extent, becomes very useful if we use it to determine an alarm level: in such a line it is useful to carry out further research chiefly towards evaluation techniques of impulsive noises, which are present particularly in many factories and workshops. Bearing in mind this consideration and also that:

- the same sound level expressed in dB A can be realized with different spectral contents,
- sounds with the same level in dB A and the same spectral content can variously influence the human ear depending on the acoustic environmental conditions,

discussion about quantification of absolute levels which must not be exceeded or about computation technique of noise-dose, becomes meaningless. Rather, it is of great importance to lay down a procedure to medically control workers who are exposed to noise which exceeds a certain guard level: as it assumes the function of alarm, this level must be discovered with

criteria of ample security. Such a procedure, even if not clearly stated by the law, can be requested on the basis of the law of 1970 and is already applied, in various ways, at a national level and particularly in many fact ries in Emilia-Romagna region.

APPLICATION OF TIME-SERIES ANALYSES TO LEQ-MEASURES OF ENVIRONMENTAL IMPULSE NOISE*

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SUMMARY

The application of time-series analysis to short-term Leq's of impulse noise has shown that the detection of impulses is possible even for rather complex signals containing various types of environmental noises. Of course, this discrimination technique is still at its beginning and several refinements are being called for.

Concerning the algorithms themselves, several aspects need to be studied further, such as :

- the effect of the order of the model,
- the use of a weighting time window,
- the problem of synchronizing simultaneous measurements.

Data acquisition also deserves further attention along the following lines :

- effect of the integration time of the Leq's,
- effect of A or other frequency weightings.

A Common Sense Approach to Workplace Noise Regulation

Terrence A. Dear, FIOA
Principal Consultant
Engineering Department
E. I. du Pont de Nemours & Co., Inc.
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SUMMARY

The 90 dBA per 8-hour criterion with a 5 dB(A) exchange rate, should be used as the basis for technical or engineering controls in workplace noise regulation. A hearing conservation program should be required first and foremost to protect workers from potential noise-induced hearing impairment on an individual basis, beginning at 85 dBA. A 3 dBA exchange rate based upon an equal energy hypothesis is not valid according to Sulkowski,[6] Scheiblechner[10] and others. Henderson[7] has shown that EEH is not appropriate where there is impulse noise present.

Protecting all workers from potential hearing impairment due to industrial noise exposure is an attainable goal.[11] More than twenty-five years' experience in Du Pont prove it. A hearing conservation program, with medical surveillance, audiometric testing, training and hearing protection where necessary and appropriate, is a tested and practical procedure. Present and proposed noise regulations, establishing preference for technical methods or engineering controls to some risk related criterion level, cannot produce such protection for as many individual workers in industry. Practical technical methods or engineering controls necessary to meet a 90 dBA criterion level are not generally available[12] and 85 dBA would further emphasize their impracticality.

ULTRA-AUDIOMETRIC STUDY OF 'NORMAL' NOISE-EXPOSED LISTENERS

Filipo, R. and De Seta, E.

Department of Audiology, Rome University, Rome, Italy

SUMMARY

Pure-tone and impedance audiometry was carried out on a group of noise-exposed workers. From this group we selected 24 subjects with normal outcome to the previously mentioned tests and they underwent high frequency audiometry testing.

The results enabled us to ascertain that there is no significant difference in the average high frequency function between this group and the control group which belonged to the same decade. We conclude that high frequency audiometry is not to be considered a predictive index of conventional audiometric noise-exposure damage.

ENVIRONMENTAL RESEARCH PROGRAM: EFFECTS OF NOISE ON HUMAN BEINGS

Gottlob, D.

Federal Environmental Agency, Berlin, Federal Republic of Germany

SUMMARY

This paper gives an overview over the research activities of the Federal Environmental Agency. The subjects of terminated and current projects are reported. The direction for future research is discussed.

HEARING DAMAGE CAUSED BY IMPULSE NOISE - RESULTS OF A SWISS INVESTIGATION

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Acoustics Laboratory, Swiss Federal Institute of Technology, 8092 Zurich

SUMMARY

Different impulse noise measuring methods were compared in the field using a specially developed mobile measuring system.
Evaluation of PTS and noise exposure data of over 250'000 persons as well as more than 600 cases of acoustic trauma from weapons led to the following conclusions:

- the impulse correction after DIN/VDI overrates the hazard of impulses;
- a crest-factor correction is not justified for LEQ values determined with integrating sound level meters;
- mechanical damage to the inner ear may occur above 125 dB(A) SEL (sound exposure level, LAX);
- frequency weighting according to the ear's transfer function is necessary also for impulse noise.

THE TOTAL-ENERGY AND EQUAL-ENERGY PRINCIPLES IN THE CHINCHILLA.

Ward, W.D., Turner, C.W. and Fabry, D.A.

Department of Otolaryngology, University of Minnesota,
2630 University Ave. S.E., Minneapolis, MN 55414, USA.

SUMMARY

In the chinchilla, hair-cell damage produced by a single essentially uninterrupted exposure to 700-2800-Hz noise is proportional to the square root of the total energy of the exposure (and hence proportional to the pressure, if exposure duration is held constant). Breaking an exposure of 2100 joules/m^2 down into 45 equal exposures on a work-week schedule results in about half as much damage, although permanent threshold shifts are about the same. Support for the equal-energy theory of damage (i.e., that the temporal distribution of energy within a workday is unimportant) is provided by the finding that the same damage was produced by 45 480-min exposures at 92 dB SPL and by 45 48-min exposures at 102 dB SPL. However, the applicability of the results to human exposures is uncertain because of the fact that the chinchilla shows much less overnight recovery from a given degree of auditory fatigue than does man.

REDUCING INDIVIDUAL SUSCEPTIBILITY TO NOISE DAMAGE -- HISTORICAL REVIEW AND PROPOSAL FOR INTERNATIONAL COLLABORATIVE RESEARCH

Lipscomb, D., Harris, G. and Dubrowski, R.

Department of Audiology & Speech Pathology, University of Tennessee, Knoxville, Tennessee, USA

SUMMARY

It is proposed that representatives of industry in different nations engage in a cooperative study with our coordinative efforts. Using the basic research design described above and utilizing rebreathers we will provide for workers, we hope to collect and analyze valuable data concerning the efficacy of rebreathers as physiological hearing protective devices for use in industrial settings for employees marginally exposed to noise or for whom hearing protection is inadequate.

THE CURE FOR NOISE-INDUCED HEARING LOSS IS PREVENTION

Anne E. MacNaughton

Civil Service Technical Guild, Local 375, New York, N.Y.

SUMMARY

"We are almost overwhelmed in an ocean of noise." So warned Herschell E. Reilley, McGill physicist and pioneer in acoustics and noise control. The year was 1935.

Almost fifty years later, our ears are drowning in the din of recreational vehicles, lawn and workshop equipment, and unlimited indoor and outdoor amplification. Word of the imminent and painless danger to hearing of excessive sound never reaches the ears of the vast numbers of people who need to know. Nor do they hear of simple, safe and inexpensive means of protection. We can, and we must, change this situation.

TINNITUS AND OCCUPATIONAL EXPOSURE TO NOISE

Merluzzi F., Duca P.G., Ciuffreda M., Di Credico N. and Cantoni S.

Institute of Occupational Health, University of Milan, Milan, Italy
Institute of Medical Statistics and Biometry, University of Milan, Milan, Italy
Department of Occupational Health, U.S.S.L. 75, Milan, Italy

SUMMARY

In order to assess the possible relationship between noise, age, hearing threshold and tinnitus, a study was made on a group of 577 male workers employed on tramcar body repair shops. Noise levels in the workplace were measured, and the 577 workers underwent tonal audiometric examination. A questionnaire was used to investigate tinnitus: 28% of the subjects complain of tinnitus. The annoyance was in 53 cases (9%) slight, in 65 (11%) moderate and in 46 (8%) severe.
Of the 4 variables considered, the most strongly associated with tinnitus was hearing threshold, followed by exposure to noise. It is concluded that probably the factors causing hearing damage predispose also towards tinnitus. Since noise is responsible for a large number of cases of hearing loss, it should be considered the most relevant one.

TOPODIAGNOSTIC PHYSIOGNOMY OF NOISE INDUCED HEARING LOSSES

Quaranta A. and Mininni F.

Department of Otolaryngology, University of Bari, Bari, Italy

SUMMARY

This study takes into consideration the behavioural pattern of pure tone topodiagnostic tests in 77 subjects with noise-induced hearing losses (32 railway engine drivers, 29 metal industry workers and 16 cement industry workers). For each single subject it was studied the behaviour of tests for cochlear functions (recruitment and elasticity of the cochlear partition); for retrocochlear involvement (adaptation phenomenon); and for central auditory impairment (binaural interaction). The results have shown that the topodiagnostic physiognomy of noise-induced hearing losses is characterized by the presence of recruitment in 52% of the cases and by the unusual finding (9%) of tone decay; the harmful action of noise exposure does not affect the elastic properties of the vibratory elements, carriers of the acoustic wave; the noise functional damage is limited to the 1st neurone.

STUDIO DEL RUMORE E DEI SUOI EFFETTI UDITIVI IN UN'INDUSTRIA METALMECCANICA

Ratti, R.* - Cirla, A.M.** - Brini, D.* - Sala, C.**

* Servizio Tutela della Salute nei Luoghi di Lavoro - U.S.S.L. n° 16-Lecco
** Servizio di Medicina del Lavoro -Ospedale di Lecco- U.S.S.L. n° 16

SUMMARY

E' stata compiuta un'indagine sul rumore e sui suoi effetti uditivi in una grossa fabbrica metalmeccanica. La fabbrica in esame lavora gli elementi per la costruzione di tralicci di sostegno per elettrodotti, cioè piastre e profilati di acciaio. Il rischio prevalente ed ubiquitario è quello di una elevata rumorosità di tipo soprattutto impulsivo. I risultati dimostrano che i livelli sonori prevalenti variano da un minimo di 95 a un massimo di 126 dBAI. Lo studio degli effetti del rumore sugli operai della fabbrica è stato impostato esaminando tutti gli operai addetti, indipendentemente dall'età e dall'anzianità lavorativa; in totale sono stati esaminati 324 soggetti di sesso maschile con età media di 38,3 anni. Per ogni soggetto è stata effettuata: anamnesi otologica; audiometria tonale; otoscopia diretta, tutte con procedure e criteri di screening. L'incidenza delle compromissioni uditive da rumore è apparsa molto rilevante, pari al 71,9% sul totale. Il dato viena confermato anche dallo studio di un gruppo di 142 persone esposte a rumore impulsivo solo in questa fabbrica.

USE OF SNOW-MOBILES AND HEARING LOSS AMONG REINDEER HERDERS.

Sorri, M., Sipilä, P., Pirilä, T. and Karjalainen, H.

Department of Otolaryngology, University of Oulu, Oulu, Finland.

SUMMARY

In a material of 334 Lappish reindeer herders, 54 right and 55 left ears exhibited hearing losses falling into class IV in the Finnish classification for occupational hearing screening. This means that that the PTA of these ears was worse than 20 dB. The AC thresholds for the left ear were worse on the average. The correlations between the hearing loss and the amount of the use of the snow-mobile were high. Only 109 of the subjects used hearing protectors regularly when driving. When unprotected, the left ear seemed to be more susceptible to noise trauma.

TEMPORARY THRESHOLD SHIFT AFTER EXPOSURE TO NOISE AND MUSIC OF EQUAL ENERGY

Lindgren, F. and Axelsson, A.

Department of Audiology, Sahlgrens Hospital, Gothenburg, Sweden

SUMMARY

Ten volontary subjects were exposed to 10 minutes of recorded pop music on five occasions. On five other occasions these subjects were exposed to a noise with level-, frequency- and time-distribution characteristics, measured in octave-band steps, equal to those of the music. Measurements of temporary threshold shift showed almost equal sensitivity to the two stimuli in four subjects, while six others demonstrated marked differences in sensitivity. Differences were always due to more temporary threshold shift after exposure to the non-musical noise stimulus. These findings imply that other factors than physical properties of the fatiguing sound contribute to the degree of temporary threshold shift.

Venerdì 24 giugno 1983 - ore 14,30
Friday, June 24, 1983 - 2,30 p.m.

Gruppo di Studio n. 2
Team No. 2

Rumore e problemi di comunicazione
Noise and Communication

Chairman: J.C. Webster (U.S.A.)
CoChairman: T. Houtgast (The Netherlands)

Invited Papers

STANDARDIZED METHODS FOR MEASURING SPEECH LEVELS

Pearsons, Karl S.

Bolt Beranek and Newman Inc., 21120 Vanowen Street, Canoga Park, California 91305

SUMMARY

No standard method currently exists for measuring speech level. However, measures are employed which use VU meters, sound level meters, graphic level recorders, sound spectograms and integrating sound level meters.

Although many of these instruments provide measures which allow consistency within an experiment, the difficulty is in providing a measure of speech which allows comparison between experiments or between laboratories. The ideal speech measure is one which is simple, repeatable and minimally effected by pauses between words and background noise.

A working group in the U. S. is currently developing a standard which incorporates the Equivalent Peak Level (EPL). This measure provides an estimation of a peak assuming a known distribution of speech levels above some "threshold". In addition, Leq may be employed for situations in which no long pauses between words exist and background levels are at least 35 dB below the speech peaks.

EXPERIMENTAL VERIFICATION OF THE STI: A VALID BASIS FOR SETTING INDOOR NOISE LEVEL CRITERIA

Houtgast, T. and Steeneken, H.J.M.

Institute for Perception TNO, Soesterberg, The Netherlands

SUMMARY

This paper summarizes recent experimental data on the validity of the Speech Transmission Index (STI) in reflecting the effect of a speech transmission channel on speech intelligibility. The approach is shown to be broadly applicable: to interfering noise, reverberation and other types of disturbances, to various types of intelligibility scores, to normal-hearing and hearing-impaired subjects and to various languages. These data emphasize the significance of the indoor noise level criterion, as derived previously on the basis of the STI calculation scheme, which is recalled briefly at the end of this paper.

EFFECTS OF NOISE AND REVERBERATION ON THE SPEECH-RECEPTION THRESHOLD OF HEARING-IMPAIRED LISTENERS

Plomp, R., Duquesnoy, A.J. and Smoorenburg, G.F.

Faculty of Medicine, Free University, Amsterdam, and
Institute for Perception TNO, Soesterberg, The Netherlands

SUMMARY

This paper summarizes the results of a series of recent experiments on the speech-reception threshold (SRT) of hearing-impaired listeners for sentences (50-% correct score) as a function of noise level and the presence of reverberation. The main results are: (1) the dependence of SRT on noise level is determined by two asymptotes: SRT in quiet as an absolute level and SRT in (high-level) noise as a speech-to-noise ratio; (2) the hearing loss for speech in noise (= SRT in noise relative to the reference value for normal-hearing listeners) increases rapidly beyond the age of 60; (3) the trade-off between the effects of noise and reverberation given by the Speech Transmission Index holds also for the hearing impaired; and (4) predictions of the hearing handicap of noise-induced hearing loss should be based on the hearing loss for speech in noise rather than on the tone audiogram.

ACOUSTICS OF ENCLOSED SPACES FOR LINGUISTICALLY IMPAIRED LISTENERS.

Nabelek, A. K.

Department of Audiology and Speech Pathology, University of Tennessee, United States

SUMMARY

Results of these studies indicate that some listeners with audiometrically normal hearing might have problems understanding speech in noise and reverberation. The groups which are deviant from normal young adults are children below 13 years of age, learning-disabled adults, speech-impaired children, and non-native listeners. All these listeners obtained very high speech perception scores in quiet and without reverberation, but their performance was significantly lower than normal for more difficult listening conditions. They should benefit, as do hearing impaireds and the elderly, from specially-designed rooms having a short reverberation time and a very high S/N. They also should benefit from listening devices such as audio induction loops, FM and infra-red systems which have become popular in large auditoriums, churches and drama theaters.

The perceptual problems in less-than-optimal listening conditions of learning-disabled and speech-impaired children should be kept in mind when therapy rooms are designed. For normal children, the perceptual problems diminish with age. Apparently, listening skills can develop in

real-life situations. However, good classroom acoustics might be helpful to improve attention and learning of small children. No data exist to indicate if all perceptual problems of non-native listeners decrease with time of exposure to the language, but it is not very likely since some of Bergman's and our listeners had been using English or Hebrew for many years.

Poster Session

EFFECTS OF NOISE ON THE EFFECIENCY OF DANGER SIGNALS

Hoege, H. - Lazarus, H. - Bock, M.

Ruhr-Universität Bochum - Bundesanstalt für Arbeitsschutz und Unfallforschung, Dortmund - Ruhr-Universität Bochum

SUMMARY

Thirty-six acoustic signals were judged under 4 different S/N-ratios (90/95, 90/85, 90/45, 70/45 dBA) by means of a 7-point semantic differential scale (dangerous - not dangerous). Results show a significant interaction between S/N-levels and signals, indicating that the judged dangerousness of some of the signals is affected by the noise conditions while others are not. Results are presented for 20 danger signals which are already used as warnings in factories etc. Eleven of these signals are not significantly influenced with respect to their judged dangerousness and therefore seem to be appropriate for affective signalling even under adverse noise conditions.

Giovedì 23 giugno 1983 - ore 14,30
Thursday, June 23, 1983 - 2,30 p.m.

Gruppo di Studio n. 3
Team No. 3

Effetti fisiologici extra-uditivi prodotti dal rumore

Non-Auditory Physiological Effects Induced by Noise

Chairman: J.H. Ettema (The Netherlands)
CoChairman: G. Jansen (West Germany)

Invited Papers

LATE POSTNATAL EFFECT ON CORTICOSTERONE BLOOD LEVEL, OF AN ACOUSTICAL STIMULATION PREVIOUSLY APPLIED TO MICE DURING PRE OR EARLY POSTNATAL LIFE.

Busnel, M.C., Molin, D.* and Dupont, W., Bourgeois, Ph.**

* Laboratoire de Physiologie Acoustique, I.N.R.A. - C.N.R.Z. 78350 JOUY-en-JOSAS, France.
** Laboratoire d'Endocrinologie, Faculté des Sciences 76130 MONT SAINT AIGNAN, France.

SUMMARY

Mice stimulated with sound during part of their pre or postnatal life (from conception to birth, or birth to nine days - onset of audition) reacted similarly to a later identical stimulation (corticosteroid levels were used as test of stress). While those treated from 0 to 21 seemed to have become habituate and are lest stressed when restimulated at weaning.

Those frequencies best heard by the animal are also those which prove to be most stressful. The interaction between time of prestimulation and frequency have not yet been analysed.

Wether pretreated or not, mice react to a lesser degree to an acoustic stress than to any other psychophysiological stress, like early separation from the mother or changing of environment.

PRELIMINARY EVIDENCE ON FETAL HABITUATION

Granier-Deferre,C.[+]- Lecanuet,J-P.[++]- Cohen,H.[+++]and Busnel,M-C.[+]

(+)Laboratoire de Physiologie Acoustique, CNRZ, INRA, Jouy-en-Josas France.
(++)Laboratoire de Psychophysiologie, LPN, CNRS, Gif-sur-Yvette, France.
(+++)Maternité Baudelocque, Hôpital Cochin, Paris, France.

SUMMARY

Human fetuses (37 to 39 weeks of age) have been repeatedly exposed to a pink noise stimuli (filtered under 800 Hz to prevent vibratory components) at 76 dB (measured in utero). Decreased cardiac responses (with diminishing peak amplitude, response surface and total duration) and lower limb movements have been found between the first and the following stimulations. These preliminary evidences give strength to the hypothesis of elementary fetal auditory learning.

EFFECTS OF IMPULSE NOISE ON VISUAL EVOKED POTENTIAL AND CHOICE REACTION TIME PERFORMANCE

Mäntysalo, S.

Department of Psychology, Institute of Occupational Health, Helsinki, Finland

SUMMARY

The present study compared the arousal and activation effects of two levels of impulse noise on visual information processing as reflected by the visual evoked potential and on the motor response time to a visual stimulus. It was expected that repetitively arousing stimuli such as abrupt and loud impulse noise would increase the activation level of the organism and modify the stimulus-response mechanisms differently from weak impulse noise and noiseless control conditions. The following conclusions were drawn:

- The motor reaction time to a light stimulus was slowed down in exposure to weak impulse noise and speeded up in exposure to loud impulse noise.
- The reaction time and P3 at Pz correlated negatively and only in noise exposure.
- Noise exposure affected only the potential evoked by the light stimulus to which the subject had to react with a motor response.
- The effects of weak impulse noise or its after-effects on the earlier components (P1-N2) were comparable to those of the control condition. Only the later component P3 was sensitive to weak noise, whereas the peak potential after P3 was sensitive to both weak and loud noise and their after-effects.
- The effects of loud impulse noise on the EP were different for the EP components. For the earlier components P1 and N1, only the after-effects could be detected. For the P2-N2 complex loud noise and its after-effects had distracting effects. P3 was sensitive only to noise, not to the after-effects. It

was attenuated in exposure to both weak and loud noise. The maximum peak potentials after P3 (490-540 msec and 540-590 msec) were sensitive to noise and its after-effects. The potential was negative in the noise exposures and positive after them.

- The EP to the light stimulus in noise exposure seemed to reflect at least three different phases of stimulus-response processing. They can be called (1) the P1-N1 phase; (2) the P2-N2 phase; and (3) the P3 with the peak potential measures after P3 phase.

The significance of these findings on the psychophysiological effects of impulse noise can be discussed properly only after further research. The extra-aural effects of noise cannot be discussed only in terms of arousal and activation. Aspects of both the peripheral and central nervous systems (i.e., aspects of cognitive and information processing of the noise effects) must be taken into account in further studies.

EFFECTS OF INDUSTRIAL ULTRASONIC NOISE IN PLASMA GLUCOSE AND FATTY ACIDS LEVELS.

Konarska, M.

Department of Physiology and Hygiene, Central Research Institute of Labour Protection, Warsaw, Poland.

SUMMARY

Effects of ultrasonic noise produced by industrial washers were investigated in the plasma of factory workers and experimentaly on animals /white rats/. Glucose and fatty acid levels were determined three times a day in plasma of 66 persons exposed to a noise range of 85-111 dB at 10-20 kHz and among a control group of 27 persons. All these persons had a standard breakfast twice a day.

Levels of plasma glucose, fatty acids and 17-OHCS adrenaline, noradrenaline in urine and tissue of white rats were examined during a long lasting exposition /36 days/ to noise emitted by industrial washers /10-20 kHz, 122-125 dB/.

The glucose level in plasma was the same on the exposed and on the control group of workers. The level of free fatty acids was statistically significantly lower in the exposed group. The level of total fatty acids was lower, too, but not so considerable.

The level of glucose decreases on animals in 1-3 days of exposed. However, the levels of 17-OHCS, adrenaline, noradrenaline in urine decreased significantly troughout the exposition time. Very different changes occured in the animal tissue during exposition.

These results indicate that ultrasonic noise developed changes in the neurovegetative system.

EFFECTS OF 8 h EXPOSURE TO INFRASOUND IN MAN

Ising, H.

Institut für Wasser-, Boden- und Lufthygiene
des Bundesgesundheitsamtes Berlin

SUMMARY

Effects of infrasound were investigated in a frequency range between 3 and 20 Hz with levels from 70 to 125 dB and exposure periods from some minutes to one week, with daily 8 h exposure, with a total of 100 test persons. Distinct effects as nausea or nystagmus or disturbances of the labyrinthine sense were not observed. But infrasound does act as a non-specific stressor in a similar way as does audible sound. The stress effects of infrasound will rise with the subjectively perceived loudness, i.e. both with rising sound pressure level and with rising frequency.

PHYSIOLOGICAL EFFECTS OF ENVIRONMENTAL NOISE ON NORMAL AND MORE SOUND-SENSITIVE HUMAN BEINGS

Rövekamp, A.J.M.

Sound, Light and Indoor Climate Division
TNO Research Institute for Environmental Hygiene, Delft, the Netherlands

SUMMARY

It can be concluded that exposure to environmental noise with an equivalent sound level of 75 dB(A) causes a statistically significant increase in the heart rate and respiration rate, a small increase in the systolic blood pressure and some vasoconstrictive changes. Changes of 3 up to 5 % were determined in heart rate and respiration rate. Sound-sensitive subjects reacted with larger changes than normal subjects . Only sound-sensitive subjects when exposed to road traffic noise reacted with a vasoconstriction of about 3 % and 6 %, respectively, in finger and ear lobe. In some cases sound sensitive subjects were exposed in our laboratory to noise which annoyed them very much in their daily lives.
Mostly they reacted with large changes. Especially in one case exposure to her own daily sound caused tremendous effects as doubling the heart rate, a 10 to 15 mm Hg increase of the systolic blood pressure and a vasoconstrictive reaction up to 70 % below the baseline (100 %).
The tendency to the increase in parameters of blood circulation and respiration, when subjects are exposed to noise can be explained if noise is considered a stressor.

These results lead to considering two kinds of future research in laboratory:

- study of the effects of long-duration (8 hours) environmental noise exposure with equivalent sound levels lower than 75 dB(A) on the heart rate and respiration rate to establish the level which causes no effects
- psychological and physiological experiments in which sound exposure is combined with the personal sound sensitiveness of the subjects.

Perhaps it is possible to combine these two aspects.

4th International Congress on Noise as a Public Health Problem (ICBEN) 1983, Turin, Italy

BODY SWAY CHANGES AFTER SINGLE AND PAIRED EXPOSURE TO NOISE AND WHOLE BODY VIBRATION

Manninen, O.

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SUMMARY

The results showed that the means of the maximum amplitude in body sway in both the y and x directions increased within the frequency ranges 0.06-0.10 Hz and 0.10-0.60 Hz, respectively, especially in cases where the subjects were simultaneously exposed to noise and vibration. In particular, an increase in the amplitude of vibration seemed to intensify the combined effect of noise and vibration. On the other hand, upright posture sway did not change as clearly as it might have as a result of noise alone or as a result of vibration alone when compared with the change in sway caused by simultaneously applied noise and vibration.

Poster Session

EFFECTS OF TRAFFIC NOISE ON PLASMA CATECHOLAMINES, cAMP AND CARDIOVASCULAR SYSTEM IN NORMAL SUBJECTS AND ESSENTIAL HYPERTENSIVES.

Catapano F., Portaleone P., Ferretti C., Teagno P.S., Fornaca G.F., Liberali L., Giuliani G.C., Verdun di Cantogno L.

Dept. of Internal Medicine of the University of Turin, Italy and Dept. of Pharmacology of the University of Turin, Italy.

SUMMARY

We have investigated the effects of noise stimulation exposure on blood pressure, heart rate, plasma catecholamines and cAMP in 9 normotensive and 9 hypertensive subjects.

Noise produced a significant rise of blood diastolic pressure in normotensive and hypertensive subjects; hypertensive only also showed a rise in sistolic pressure too.

Noise produced an increase in plasma catecholamine levels, affecting norepinephrine more than epinephrine and dopamine in normotensives; the response of the hypertensive subjects is characterized by a global rise of catecholamine levels, affecting epinephrine more than norepinephrine and dopamine, together with an increase in cAMP .

This findings support the view that also an usual stress as traffic noise can produce vascular, haemodinamic and hormonal changes, and may indicate a different response in the two groups.

NON-AUDITORY SYNERGISTIC EFFECTS INDUCED BY NOISE AND INHALED CHLORORGANIC SOLVENT VAPOURS

H. Diehl, H. Braun, P. Kaschny, W.R. Schmidt, W. Schill

Biophysical Group, Fachbereich 1, Universität Bremen

SUMMARY

In experiments with rats, liver as the main target for the metabolization of chemicals is affected to a higher extent when noise is applied together with chemicals compared to the effect which chemicals have alone. Rat exposed to noise pollution alone show no effects compared to control rats.

Subjective and physiological response to intermittent noise.

T. Gjestland

ELAB
The Norwegian Institute of Technology

M. Nivison, H. Ursin, H. Nordby

Institute of Physiological Psychology
University of Bergen, Norway

SUMMARY

A number of test persons have been exposed to noise burst in a general background noise. The time between each burst (inter-trial-interval) was varied from 45 sec. to 10 minutes. The physiological response of the test persons, i.e. skin conductance, finger pulse amplitude and heart rate was monitored. At the end of each test sequence the test person answered a questionnaire concerning their subjective response to the noise stimulation.

The results show that there is no clear correlation between total noise dose exposure and subjective and physiological response.

MULTIPLE SKIN CONDUCTANCE RESPONSES TO AIRCRAFT NOISE WITH VARYING RECRUITMENT TIMES

Hygge, S

The National Swedish Institute for Building Research, Gävle, Sweden

SUMMARY

This study was designed to examine the effects of varying recruitment times of aircraft noise, and to learn more about skin conductance responses in noise research. A dependent measure x recruitment time x noise pattern x peak level x sex factorial design was employed, with sex as the only between-subject factor. Dependent measures were skin conductance responses in six time intervals, and annoyance ratings. It was predicted that recruitment time would increase responding and that responding would not decrease with trials.

The results indicated that recruitment time did not confirm the predictions. Responses did not decrease with trials, as predicted. Actually, annoyance ratings increased. Also, it was concluded that skin conductance responses could be a useful dependent measure in noise research.

TRAFFIC NOISE AND HYPERTENSION. THE BONN TRAFFIC NOISE STUDY.

Hermann Neus, August-Wilhelm von Eiff, Heinz Rüddel, Wolfgang Schulte

Dept. Internal Medicine, University of Bonn, 53 Bonn, F.R.G.

SUMMARY

Due to recent studies there is increasing evidence that environmental noise enhances the risk for essential hypertension. With regard to this noise effect there is no sex-specific behavior. Subjects with a family history of hypertension are particularly endangered. The role of psychological factors should be further darified.

NON-AUDITORY EFFECTS OF LOW FREQUENCY NOISE

Osguthorpe, J., Mills, J. and Osguthorpe, N.

Department of Otolaryngology, Medical University of South Carolina, Charleston, S.C., U.S.A., 29425.

SUMMARY

The non-auditory effects of low frequency noise exposure in humans seem consistent with those recently reported at higher frequencies. The changes observed in this study are conservative as the only stressors were the constant noise and 3 venipunctures. The potential for intermittent/unpredictable noise, task demands and other distractions to increase these somatic responses has been well documented in other studies. Whether the cortisol elevation in both the noise groups, and the blood pressure trend of the 90 dBA subjects, would have persisted or increased with repeated exposure is not known.

INFLUENCE OF INDUSTRIAL INFRASONIC NOISE ON NERVOUS SYSTEM.

Szelenberger, W., Konarska, M., Augustyńska, D. and Pochrzęst, B.

Central Research Institute of Labour Protection, Warsaw, Poland and Department of Psychiatry, Division of Electroencephalography and Clinical Neurophysiology, Medical Academy, Warsaw, Poland.

SUMMARY

In 10 healthy subjects electroencephalogram, electrocardiogram and skin temperature were recorded during 1 h exposition to tape-recorded industrial infrasonic noise. Before and after the exposition audiogram and brain stem auditory evoked potentials were recorded. Moreover in 6 subjects the level of free fatty acids in blood was estimated. After 50 min exposition a test for eye-hand coordination was performed and reaction time was measured. All the data were compared with randomly ordered similar experiments but performed in silence. The most significant result was the prolongation of reaction time. Free fatty acids level was increased in 5 persons. In 8 subjects skin temperature was lower during the exposition to the noise. The authors conclude that the influence of infrasound is nonspecific and depends on the excitation of neuro-hypophyseo-adrenal axis.

EFFECTS OF NOISE ON THE CARDIOVASCULAR SYSTEM: APPRAISAL OF EPIDEMIOLOGIC EVIDENCE.

Thompson, S.J.

Department of Epidemiology and Biostatistics, School of Public Health, University of South Carolina, Columbia, South Carolina, USA

SUMMARY

A critical analysis of the world literature on the effects of noise on the cardiovascular system revealed no specific patterns of heart rate, cholesterol, B-lipoproteins or electrocardiographic changes in response to noise. Cross-sectional studies reported high levels of noise to be associated with elevated blood pressure.

It is recommended that future noise effects research include synthetic retrospective-cohort studies of occupationally exposed workers, intervention studies with noise abatement and hearing protection programs, adequate sample sizes, control for confounding variables, and use of analytic techniques such as Mantel-Haenszel procedures, regression/covariance analysis, logistic analysis and Cox's proportionate hazards model. Collaboration of scientists among countries should be encouraged. (EPA Contract No. 68-01-6274)

Giovedì 23 giugno 1983 - ore 9,00
Thursday, June 23, 1983 - 9,00 a.m.

Gruppo di Studio n. 4
Team No. 4

Influenza del rumore sul comportamento e sul rendimento
Influence of Noise on Performance and Behaviour

Chairman: E. Gulian (England)
CoChairman: S. Cohen (U.S.A.)

Invited Papers

PHYSICAL NOISE VS. SEMANTIC NOISE: THE EFFECT ON INFORMATION PROCESSING.

Dornic, S.

Department of Psychology, University of Stockholm, Sweden.

SUMMARY

This contribution has compared the effect of loud physical (meaningless) noise with that of low-intensity semantic (meaningful) noise on performance and perceived effort in a continuous, high-load information processing task. Task duration had a differential effect on the influence of the two noises, indicating adaptation for physical noise but pronounced deterioration of performance, accompanied by a clear increase in perceived effort expenditure, in semantic noise. The difference is mainly attributed to the greater "interrupting power" of semantic noise on tasks involving continuous information processing.

NOISE SLOWS PHONOLOGICAL CODING AND MAINTENANCE REHEARSAL: AN EXPLANATION FOR SOME EFFECTS OF NOISE ON MEMORY

Wilding, J.M. and Mohindra, N.K.*

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SUMMARY

Many experiments have now shown that white noise during the presentation of items to be learned can aid or induce recall in the original order of presentation. Also a decline in the organization of recall by grouping semantically related items has sometimes been observed following presentation in noise.

Our findings suggest that, if the task or instructions already induce subvocal maintenance rehearsal of the material in its original form, noise will slow this rehearsal due to an impaired access to the phonological codes necessary for such rehearsal. The effects of such slowed rehearsal on performance will depend on task parameters such as the measure taken, the articulatory duration of the items and their confusability with each other.

Direct tests of the efficiency of semantic processing in noise have not succeeded in identifying any impairment. The decreased use of semantic organization at recall, it is suggested, occurs because of a failure to abandon the initial maintenance rehearsal strategy in favour of a superior strategy based on semantic organization as the task proceeds. This failure is probably due to difficulty in identifying the possibility of an alternative strategy when rehearsal is slower and more demanding.

Possible effects of noise on other tasks are discussed briefly in the light of this analysis.

* now at Applied Psychology Unit, Admiralty Marine Technology Establishment, Queens Road, Teddington, Middlesex.

DIFFERENTIAL EFFECTS OF NOISE AND SPEECH ON VISUAL SHORT-TERM MEMORY.

Salamé, P.

CNRS, Centre d'Etudes Bioclimatiques, Strasbourg, France.

SUMMARY

Three experiments are reported aiming to explore the respective effects of noise and unattended speech on visual STM. Exp.1 using a 75 dB(A) SPL of noise or speech showed a clear impairment of performances in the unattended speech condition but no effect of noise was found. Exp.2 using a 95 dB(A) SPL lead to similar results. Covert rehearsal as well as a possible asymmetric transfer due to the Latin Square used in these experiments may explain the lack of noise effect. Exp.3 used an independant group design and explored the effects of articulation and of 95 dB(A) noise on the same visual memory task. The results pointed out the strong advantage of articulation and failed to show any noise effect. It is concluded that a) although noise and speech are somehow comparable on an environmental point of view, they lead however to quite dissimilar effects on visual STM and b) noise does not mask inner speech, but unattended speech does.

NOISE-INDUCED STRATEGIES DURING PHONEMIC AND GRAPHEMIC PROCESSING IN A MEMORY DUAL TASK.

Wittersheim, G. - Simon, D.

Centre d'Etudes Bioclimatiques, C.N.R.S., Strasbourg, France.

SUMMARY

The aims of the present investigation were to examine the effects of speech-spectrum noise on the performance on either component of a dual memory task using the Brown-Peterson paradigm, and a distractor recall procedure under both unexpected (first session) and expected (second session) recall. Experiment 1 used a phonemic modality and was partially a replication of Rundus' 1980 study. Subjects were led to believe that only a test of memory for numbers was required and that the individual words they had to rehearse overtly for 6, 18, 36 or 60 sec. between each number presentation, were mere distractors. Yet at the end of the whole list of 20 number word pairs they were asked for written free recall of the distractor words. Thus while in session 1 the word recall test was wholly unexpected, it was expected in session 2. It was hypothesized that an adverse noise condition (93 dBA) entailing the complete masking of auditory feedback would induce a change in the processing strategy, especially when subjects had to store meaningfull material for a delayed recall. The results mainly showed that, except for a flattening of the serial position curve, there were no reliable effects of noise on either task component. In experiment 2, a graphemic modality for the presentation of distractor words was used, but the subjects were prevented to articulate the displayed words by saying a redundant irrelevant word in response to each word repetition (6, 18, 36 or 60 times).
Again there was no reliable effect of noise on the overall word recall performance.
As for the number recall task, the analysis of the results performed on both experiments showed a significant modality by condition by session interaction ($p < .05$) indicating that in the quiet condition there was a decrease in the number error-rate when subjects switched from session 1 (unexpected word recall) to session 2 (expected recall), while the reverse occurred in the noise condition. The observed difference was larger in the phonemic than in the graphemic modality.
These results may be interpreted as an adjustment in the dual task processing strategy under noise : when the subjects expect the word recall they give a higher priority to the processing of that material at the expense of the processing of number material in spite of a latent practice effect which could account for the improvement of number recall in the quiet condition.

THE AFTEREFFECTS OF ANTICIPATING NOISE EXPOSURE

Cohen, S. and Spacapan, S.

Department of Psychology, Carnegie-Mellon University and Department of Psychology, University of Oregon

SUMMARY

The present work attempts to gain further understanding of why exposure to unpredictable, uncontrollable noise results in post-stimulation deficits in performance. Specifically, we are interested in determining the role noise exposure plays in the post-stimulation effect. In order to address this issue, we started with the most fundamental question about the relationship between exposure and post-stimulation effects. Is noise exposure necessary to produce an aftereffect? Hence we designed a study in which we attempt to produce aftereffects without exposing subjects to the noise. Our approach was influenced by recent work indicating that persons anticipating exposure often behave as if they were actually exposed. The premise is that the mere anticipation of exposure to aversive noise is sufficient to produce an effect. In short, if stressor anticipation is equivalent to stressor exposure, one would expect the same effects found after exposure to noise to occur after the mere anticipation of exposure.

Fifty-five female subjects were randomly assigned to three experimental conditions: expecting noise exposure, expecting noise exposure with control over the noise, and not expecting noise exposure. In the first two conditions, subjects were led to believe that they would be exposed to loud dental noise. In the "control" condition, they were told that they could terminate this noise at will. After completing a number of experimental tasks, subjects were informed that because of a scheduling error, they would not have time to go through the noise experiment (i.e., the expectation that they would be exposed to noise was terminated). At this point they completed the tolerance for frustration task used as a post-stimulation measure in previous noise aftereffect studies.

Subjects who expected the noise without control had less tolerance for frustration than either those who expected noise with control or those not expecting to be exposed to the noise. These data are essentially equivalent to the results from earlier noise aftereffect research. Hence it appears that just thinking about being exposed to noise is sufficient to

to produce the aftereffect. Implications of these results for understanding how noise affects post-stimulation performance are discussed in the complete paper.

SEX, AROUSAL AND FATIGUE DETERMINING NOISE EFFECTS AND AFTEREFFECTS

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Department of Psychology, Indiana University Southeast, U.S.A.
Department of Psychology, University of Louisville, U.S.A.

SUMMARY

In an earlier publication (Baker *et al*, in press) we concluded that the effects of noise are different from arousal. Many of the present findings support this conclusion. The results reported by Lysaght *et al*--effects of different types of noise on different types of task--might be interpretable in terms of arousal.

One problem is that our terminology is confused. Arousal is an effect or a complex of effects; noise, caffeine, time of day and other variables manipulate it (them) and produce other effects. There is good physiological evidence that noise and other sensory input has certain activating properties. On the other hand as Broadbent (1971) and others have pointed out, continuous noise, especially at moderate levels, may by masking insulate us from stimuli that would otherwise activate us. Intense noise also produces emotional reactions which vary with the individual. While this is sometimes described as activation, such a view is doubtless over-

simplified. The conditioned helplessness view, which remains to be validated, would also represent an emotional effect. It is not unreasonable to believe that emotional reactions and the necessity to inhibit response to distraction produces fatigue; this might be evidenced as a lesser tendency to observe over a wide range and a reduced tendency to exert effort. There may also be effects of noise on short-term memory, though they are complex and not well understood. Our data are not readily interpretable in these terms.

While it would be desirable to explain noise effects in terms of a single mechanism, it probably is unparsimonious to do so. It is very difficult to tease out the multiple effects of noise, but we must continue to try.

4th International Congress on Noise as a Public Health Problem (ICBEN) 1983, Turin, Italy

THE EFFECTS OF NOISE ON STRATEGIES OF HUMAN PERFORMANCE

Smith, A. P.

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SUMMARY

Recent studies have shown that moderate intensity noise does influence performance. However, most theories which have suggested that human performance is shifted by noise in an invariant or mechanical fashion have been shown to be inadequate. Evidence is presented to support the general view that noise influences the control processes in human behaviour. Several specific effects of noise are distinguished. First, when a subject is free to select a strategy to do the task, noise may induce certain strategies in preference to others. Second, noise may reinforce the use of the dominant strategy so that there is often a noise-induced bias towards the operation which appears to best repay the investment of more effort. These strategy changes may be of short duration and reflect initial coping with the task or they may be longer lasting and still show up when experimental conditions are changed and when the subject is transferred from noise to quiet.

LOUD NOISE AND LEVELS OF CONTROL: A STUDY OF SERIAL REACTION.

Jones, D.M.

Department of Applied Psychology, University of Wales Institute of Science and Technology, Cardiff, United Kingdom.

SUMMARY

By showing a significant rise in the number of errors over the period of work in loud noise these findings have cast doubt on the assertion that the effects are due to a combination of masking and arousal effects of the type proposed by Poulton. Features of the data do not lend support to the idea of an initial arousing effect of noise followed by a gradual decline in arousal, culminating in a sharp drop in arousal when the noise is switched off. However, the findings do not lend themselves to any other unambiguous interpretation. One possibility is that noise serves to increase arousal and that this effect slowly accumulates during the course of the task. Yet, such a proposal fails to furnish exact predictions about the way in which the deterioration in performance should occur.

Given that noise has only a modest effect in increasing the speed of response as shown by the probability distributions for correct and incorrect responses but that it increases the likelihood that a fast response will be an error, two explanations are suggested. The first is that noise impairs the intake of information. Let us assume that the

subject attempts to maintain the same overall distribution of responses throughout the period of test. Any disruption to the intake of information is thus likely to erode the basis on which responses are made. Responses, in order to fit into the confines of the distribution, will be based on less evidence that was hitherto available. This shortage of evidence will have particularly dire consequences for those responses that are fast and it becomes more likely that they will be errors. Problematic for this view is why the distribution of response times should remain stable, particularly in view of the possibility of adjusting the distribution to reduce the number of errors at the expense of increasing overall response times. An alternative view is that noise somehow alters the placing of the criterion or the boundary that separates correct from incorrect responses. It may be, for example, that the marginal increase in overall speed of correct responses in noise could only be achieved at the expense of relaxing this criterion. Note, however, that it is the proportion of errors which is increased, regardless of the absolute number of fast responses, so that noise increases the number of responses that are 'converted' to errors.

These explanations share a similar stumbling block. Noise does not have a clear effect on the speed of responses leading to and following an error. In particular the response following an error exhibits a temporary slowing, a sign of the process of recognizing that an error has occurred. Those explanations relying on some impairment by noise of the intake of information should, unless modified, predict that noticing that an error has occurred should be impaired in the same way that selection of the appropriate stimulus is impaired. Criterion

shifts suffer a similar fate: the rate at which the speed of response returns to normal in the five or so responses following an error is most likely to show a speeding in loud noise as the result of a relaxation in criterion (see Laming, 1979).

In sum, we can only offer an equivocal account of the processes governing the effect of noise on serial reaction. However, some explanations can be shown to be untenable. It is likely that further fine-grained analyses of task performance will illuminate the complex control processes which govern task performance. This quest may contribute to our general understanding of the effects of noise on performance since these seem to be in large part governed by high-level control processes which give rise to effects of the strategic type (see Jones, 1983 for a general overview).

COMBINED EFFECTS OF BROADBAND NOISE AND COMPLEX WAVEFORM VIBRATION ON COGNITIVE PERFORMANCE

C. Stanley Harris and Richard W. Shoenberger

Air Force Aerospace Medical Research Laboratory
Wright-Patterson Air Force Base, Ohio 45433

SUMMARY

The performance of 12 subjects was measured on a Complex Counting Task during exposure to each of four experimental conditions for a duration of 30 min. Two levels of noise, 65 dBA and 100 dBA, were presented both with and without 0.36 R.M.S. G_z sum-of-sines vibration. Combined 100 dBA noise and vibration produced less adverse effects than the vibration combined with 65 dBA noise. This result agrees with our previous studies using tracking tasks. However, two effects were demonstrated that had not been obtained previously. First, a clearcut adverse effect of vibration on the Counting Task was obtained. Second, an adverse effect of 100 dBA noise on the counting task was demonstrated. Previously, a 110 dBA noise was required to adversely affect tracking performance.

TASK TYPE, TYPE A AND B BEHAVIOR PATTERN AND SENSITIVITY TO NOISE

Moch, Annie

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SUMMARY

The present study examined the sensitivity to noise in type A and B behavior pattern as a function of the type of task.

Twenty type A and twenty type B subjects selected by Bortner's french version scale, have been exposed to increasing noise (68 to 110 DbA) as they were supposed to begin with a cross-out test, and to do later a nonsense syllables memorization task.

The results showed that type A or B subjects react differently : type A behavior pattern subjects maintain their level of tolerance consistently, on the other hand type B lower theirs.

No difference was found on the simple task between groups, but in the more complex one (nonsense syllable memorization) type B are more sensitive to noise.

Investment in the task and desire to succeed may lead type A subjects to pay less attention to acoustic cues, but they may also have used other cognitive mechanism to cope with noise, like avoiding thinking about the aversive aspects of the situation which could make them deny negative features of the experience.

It is the way they react to the environment as they are working which explains difference between subjects, since a post-experimental rating on a seven point scale of three noises (low, high, medium) showed no difference between type A and type B subjects.

The type A subject appears to overadapt to stressfull situations which may explain the potential risk of cardiovascular disease encountered.

ANNOYANCE AND PERFORMANCE

Moser, G. and Jones, D.M.

Institut de Psychologie, Université de René Descartes, Paris.
Department of Applied Psychology, University of Wales Institute of Science and Technology, Cardiff, United Kingdom.

SUMMARY

Performance was assessed in an auditory version of the Bakan vigilance task under conditions of masking by background noise and conditions of incentive. Subjects were asked to rate annoyance during the task and for the same noise in a setting outside the laboratory together with estimates of the number of misses and false alarms they had made. During the task masking reduced the number of hits and incentive reduced the number of false alarms. Annoyance during the task depended on the degree of masking. Annoyance 'while sitting quietly and relaxing' was greater if either or both incentive and noise had been present. The association between estimated and recorded hits was poor, but that for false alarms was good in all except the case of no-incentive and no-masking. Conditions of masking and incentive present a greater challenge to the individual which leads to a greater engagement in task performance.

Poster Session

Noise, exposure, labour conditions and Anxiety. Test data for the State-Trait Anxiety Inventory (STAI)

CASARI E.F.*, DOMINICI R.**, BERNACCHIO E.**, PREDONZANI A.**, ROSSI S. **, SERIO A.**.

Psychology Institute, Medical Faculty University of Genova.*
Medical Service of Italian Rail ways **

SUMMARY

A group of 381 railway workers esposed to noise, has been subjected to the State and Trait Anxiety Inventory, in order to point out the possible correlation between noise exposure and anxiety state. While the audiometric tests to which the workers have been subjected have shown a progressive and significant increase in the incidence of bradyacusia with the progressing of age and of noise exposure, on the contrary the average levels of state and trait anxiety don't seen to be correlated with noise.

EFFECT OF NOISE ON CHILDREN AT SCHOOL

Lehmann, A. and Gratiot Alphandery, H.

Laboratoire d'Acoustique Animale, E.P.H.E., Jouy en Josas, France.

SUMMARY

The behavior of children in school is greatly affected by reduction of noise in their classroom. Our hypothesis that insulation of the classroom will improve children's behavior and their social contact, whatever their age was supported. The children themselves indicated that they were more concerned by noise during school work than by noise at home and that they appreciated the insulation of their classroom. We also found that the more agitated children who lived at home in the noisiest and more crowded environments were the most improved by insulation. This shows that children living in more difficult conditions are more sensitive to environmental improvement.

EFFECTS OF NOISE AND RATE OF PRESENTATION ON REHEARSAL IN SHORT TERM SERIAL ORDER MEMORY.

N. Mohindra.

Applied Psychology Unit, Admiralty Marine Technology Establishment, Queens Road, Teddington, Middlesex, England.

SUMMARY

Noise effects were explored in a serial order memory task using very fast rates of presentation in order to prevent the occurrence of phonological coding and rehearsal. However, opportunity for retrieval of phonology was provided on certain trials by slowing presentation rate or by incorporating a delay period prior to recall being required. Although fast presentation rates almost eliminated the phonemic similarity effect, noise improved recall of items followed by the delay interval. At slower rates of presentation noise helped recall of acoustically similar items, especially when subjects engaged in overt articulation during presentation. These results were interpreted as supporting the notion that retrieval of phonological codes necessary for rehearsal is less efficient in noise and that in these conditions more time has to be made available for such processes to operate satisfactorily.

STUDYING THE AFTER-EFFECTS OF NOISE ON REACTION TIME BY APPLICATION OF VARIOUS MODELS OF TIME SERIES ANALYSIS

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Universität Düsseldorf, Institut für Arbeitsmedizin,
Bundesrepublik Deutschland

SUMMARY

Our results suggest, that time series analysis is a useful method for the examination of reaction time data. The existence of a stable rhythmic component could be demonstrated. Studying the after-effects of noise on the derived variables of the spectral analysis shows no significant changes in the variables with regard to different experimental conditions. This result leads to the assumption that the rhythmicities are not affected by short trials because of their stability. Therefore the duration of the trials should be extended when studying after-effects of noise. Furthermore it seems to be useful to study direct-effects of noise on reaction time with the help of time series analysis.

NOISE SENSITIVITY AND PSYCHIATRIC DISORDER IN A COMMUNITY SAMPLE

Stansfeld, S.A.

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SUMMARY

A standardised measure of psychiatric disorder, the Present State Examination and McKennell and Self Report measures of noise sensitivity were used to study a representative sample of 77 women drawn from the West London Survey of Aircraft Noise and Psychiatric Morbidity. "High Noise Sensitive" subjects were compared with "Low Noise Sensitive" subjects in areas of high and low aircraft noise. High noise sensitivity was significantly associated with high P.S.E. mean symptom scores and possible psychiatric caseness in the high noise but not the low noise area. Noise stress is seen as a precipitant of psychiatric morbidity in noise sensitive subjects.

THE SUBJECTIVE SYMPTOMS AND NOISE ANNOYANCE OF WORKERS EXPOSED TO IMPULSE NOISE AND CONTINUOUS NOISE

Vuori, J.

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SUMMARY

The results showed that compared to controls, the groups exposed to noise had significantly more subjective symptoms of neurotic nature. The appearance of symptoms was not uniformly related to the duration of noise exposure. Other environmental and individual factors can modify the effects of noise on the prevalence of symptoms (Tarnopolsky et al. 1980).

Compared with the workers exposed to continuous noise, the workers exposed to impulse noise had more symptoms of concentration difficulties. They also rated the noise in their environment as more detrimental to work. Impulsive noise often has a complex and unpredictable temporal structure, and can have a more distracting influence on performance than noises with a simpler temporal structure.

Venerdì 24 giugno 1983 - ore 9,00
Friday, June 24, 1983 - 9,00 a.m.

Gruppo di Studio n. 5
Team No. 5

Rumore e sonno
Noise Disturbed Sleep

Chairman: A. Muzet (France)
CoChairman: B. Griefahn (West Germany)

Invited Papers

DISTURBANCES OF SLEEP - INTERACTION BETWEEN NOISE, PERSONAL, AND PSYCHOLOGICAL VARIABLES.

Griefahn, B. and Gros, E.

Institute for Occupational Health, University of Düsseldorf, Düsseldorf, Federal Republic of Germany

SUMMARY

The sleep of 10 couples, 25-63 years was recorded during 12 consecutive nights each. The subjects lived in streets with high traffic load for at least 14 months. Sleep recordings were executed in the subjects' own sleeping room under both noisy and quiet conditions. For 5 couples, usually sleeping with closed windows noise level was raised by opening the windows during the 6th to 10th night. For the other 5 couples noise then was attenuated by using earplugs.

Between noisy and quiet conditions (difference 9 dB(A) for L_1) several alterations were found. Though numerically small they were significant on the 1%-level.

For all subjects combined stage-4-latency was increased during noise, the number of sleep cycles was reduced, and sleep latency was assessed to be longer.

For the particular subgroups the following alterations were recorded during noise:

1 EEG-data

- sleep latency increased: earplugs-group, more than 4 years residence

- stage-4-latency increased: female, younger subjects, more than 4 years residence
- slow-wave-sleep during 1st sleep cycle decreased: younger subjects, up to 4 years residence
- stage REM during 1st sleep cycle increased: older subjects, more than 4 years residence
- stage REM during total sleep increased: younger subjects, more than 4 years residence
- number of sleep cycles decreased: earplugs-group, female, older subjects

2 Subjective assessment
- sleep quality decreased: windows-group, female
- sleep latency increased: windows-group, demale
- intermittent wakefulness increased: female

3 Performance
- qualitative impairment: male, older subjects, more than 4 years residence

From multivariate analysis it was found that people living more than 4 years in noisy environments tend to have less Delta sleep. This may be interpreted as an increased sensitivity to noise.

SLEEP DISTURBANCES CAUSED BY NOISE: ANALYSIS OF A CROSS-SECTIONAL INQUIRY

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Bundesrepublik Deutschland

SUMMARY

Our data suggest, that in conformity with our expectations annoyance is closely related to subjective sleep quality, i.e. self-estimation as a poor sleeper, difficulties to get asleep, often nightly occurring awakenings, sleep length, worries about poor sleep and unpleasant dreamings. Age, health and noise susceptibility are the most important moderator variables between noise annoyance and sleep: With increasing age, bad health and noise susceptibility, the perceived annoyance is growing, while sleep quality will be assessed worse. Smell and dust annoyance are also correlated with sleep quality; compared with noise annoyance they are of lower importance.

SLEEP DISTURBANCES - AFTER EFFECTS OF DIFFERENT TRAFFIC NOISES

Öhrström, E.

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SUMMARY

The laboratory experiments have shown that the sleep quality index (SQI) is well related to the peak noise dose. Body movements frequently occurred immediately after a peak noise event and were significantly related to subjective awakenings and irritability in the morning. It is suggested that future sleep studies should incoperate measurements of SQI, performance and mood to elucidate after effects of noise-induced sleep disturbances. These measures, as well as body movements, allow for large-scale investigations in the field which are necessary in order to study long-term effects of environmental noise on sleep.

The results from the laboratory experiments and the field study show that traffic noise disturbs sleep (decreased sleep quality and mood and an increased number of body movements) at Leq-levels below 35 dB(A). Intermittent traffic noise has more adverse effects (decreased sleep quality and a tendency towards worse mood and performance) than a continuous traffic noise at the same Leq-level. Peak levels around 45

dB(A) indoors caused awakenings in the field study. The results underline the importance of peak noise levels rather than the total noise energy in Leq for sleep disturbance effects. Thus noise-reducing measures to protect against sleep disturbance effects should be focussed on a lowering of the loadest or most annoying noises.

AN ESSAY IN EUROPEAN RESEARCH COLLABORATION: COMMON RESULTS FROM THE PROJECT ON TRAFFIC NOISE AND SLEEP IN THE HOME.

Jurriëns, A.A., Griefahn, B., Kumar, A., Vallet, M. and Wilkinson, R.T.

TNO Research Institute for Environmental Hygiene, Delft, the Netherlands.
Institut für Arbeitsmedizin, Düsseldorf, Federal Republic of Germany.
Psychophysiology Laboratory, University of Amsterdam, the Netherlands.
Centre d'Évaluation et de Recherche des Nuisances et de l'Énergie, Institut de Recherche des Transports, Bron, France.
Medical Research Council, Applied Psychology Unit, Psychophysiology Section, Cambridge, England.

SUMMARY

In summary of this attempt at collaborative research the following conclusions are offered:

- An extensive field study like this requires much effort to develop partly novel experimental procedures and analysing methods, and to reach a sufficient common approach for all teams. One can hold different views whether the common approach was sufficient or not, but the collaborative experience and joint lessons learned in these matters are an important achievement in itself. As it becomes increasingly impossible to afford scattered and often duplicating research efforts, national and international research collaboration will certainly grow.
- In spite of many sources of variation this study gives clear evidence that, with respect to health, noise has adverse influences on sleep and subsequent well-being, and points the way to further research.

- For definite, quantitative pronouncements on health consequences and on noise limits at night, especially epidemiological studies are desirable.

DOES DOUBLE GLAZING REDUCE TRAFFIC NOISE DISTURBANCE DURING SLEEP ?

A. Kumar, J. H. M. Tulen, W. F. Hofman, R. van Diest, and A. A. Jurriens

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TNO Institute of Environmental Hygiene, Delft, The Netherlands

SUMMARY

An assessment of the efficacy of sound insulation of traffic noise during sleep in reducing the psychophysiological disturbance is the main issue of this paper. A psychophysiological sleep study was done in the homes of 12 subjects. The sleep recordings and psychological measurements during wakefulness were performed for 10 nights each under two conditions of normal and reduced sound level respectively.

The relationship between subjective sleep quality, and the performance and mood of subjects showed that the sound insulation is not associated with enough improvement in the restorative value of sleep. Contrary to our expectations, cardiac and respiratory responses to traffic noise were not reduced by sound insulation. These responses were caused by the phasic and transient nature of the sound level signal. The psychophysiological acoustics during sleep, of the indoor sound level of traffic noise, were not reduced by double glazing.

SLEEP DISTURBANCES BY ROAD TRAFFIC NOISE AS RECORDED IN THE HOME.

Eberhardt, J.L.

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SUMMARY

The aim of the present investigation is to study in the subjects' own home environments how the sleeping pattern is influenced by exposure to road traffic noise during different parts of the night. The subjects, who live along quiet streets without nocturnal night traffic, were exposed to the prerecorded noise of 20 truck passages (55 dB(A) peak level) during a 2.5 h period of the night: in the beginning, the middle or the end of the night. EEG, EOG, EMG, ECG and body movements were recorded digitally on a PCM recorder. The subjects completed questionnaires for evaluation of subjective sleep quality and mood.

Preliminary results concerning the sleep stage distributions for the first 5 subjects (3 males and 2 females aged 25-29 years) are presented. The most consistent trends towards deteriorated sleep were observed when the subjects were exposed in the middle of the night; the durations of awake and stage 2 increase whereas the durations of stage 3+4 and REM decrease. When exposed in the beginning of the night similar trends were observed, but the effects on slow wave sleep were much smaller whereas the effects on REM sleep were more pronounced. Exposure during the latter part of the night did not cause any observable trends.

EFFECTS OF PEAKS OF TRAFFIC NOISE DURING SLEEP ON ECG AND EEG

Wilkinson, R.T. and Allison, S.

Psychophysiology Section, Applied Psychology Unit, Medical Research Council, Cambridge, England.

SUMMARY

The electroencephalogram (EEG), electro-oculogram (EOG), and electrocardiogram (ECG) were recorded at night in 11 subjects for 3 weeks as they slept in their own homes beside very noisy arterial suburban roads. During the middle week the traffic noise was attenuated by double glazing in the bedroom windows. All the subjects were in good health, took no sleeping pills, and were long-term residents in these noisy areas. Analysis of the records is still in progress. This paper presents an interim report of the effect of peaks of traffic noise on EEG, EOG, and ECG. These records were stored for approximately 8 seconds before and 8 seconds after each peak and averaged over all peaks, i) for peaks whose levels lay in the upper and lower 50 percentiles and, ii) for peaks from the high and low noise nights. Following the noise peaks only moderate changes were observed in the physiological indices. In particular delta waves (low frequency, high amplitude frequencies in the EEG thought to reflect deep sleep) were not diminished immediately after peaks, and changes in heart rate and variability, though sometimes significant, were small. At this stage of the analysis therefore the data suggest considerable adaptation on the part of these residents to the almost continuous passage of vehicles during the night.

Nocturnal heart rate reactivity to aircraft noise, after a long exposure

VALLET M., GAGNEUX J.M., CLAIRET J.M., LAURENS J.F., LETISSERAND D.

Institut de Recherche des Transports, Centre d'Evaluation et de Recherche des Nuisances et de l'Energie - BRON FRANCE

SUMMARY

The purpose of this research is to examine the sleep quality of people living near an airport, open at night and its evolution during a period of 6 years of exposure to noise.

The sleep of 15 subjects has been : recorded in 1975 and 1982 (EEG, EKG, EMG, EOG) to prove if habituation takes place or not. The comparison is based on the heart rate reactivity. The physiological signals and the acoustic level (in dB(A)) are recorded continuously during 4 complete nights for each subject, after 3 nights of habituation wearing the electrodes. The HR reactivity is analysed for each single noise event.

The HR responses have the same percentage reported to the total amount noise (corresponding to aircraft movements) during the night. The amplitude of the responses, in beats per minute, is partly the same in the 2 phases, i.e. in the years 1976 and 1982, and partly slight decreasing in 1982, after 6 years'exposure.

BENZODIAZEPINE EFFECTS ON AROUSAL THRESHOLD DURING SLEEP.

Johnson, L. C. and Spinweber, C. L.

Naval Health Research Center, P.O. Box 85122, San Diego, California 92138-9174, U.S.A.

SUMMARY

Noise is often the reason given for poor sleep, and sedative hypnotics are frequently used to insure "deeper" sleep and fewer awakenings. In a series of studies, the effects of benzodiazepines on arousal threshold during sleep have been investigated. Two studies, one using flurazepam, 30 mg, over 10 nights and one using triazolam, .5 mg, over 6 nights were conducted in the authors' laboratory. A third study at the University of Florida measured the effects of flurazepam, 30 mg, and pentobarbital, 100 mg, each administered on two nights. All drug threshold levels were compared to placebo values.

All three studies found that the sedative hypnotics increased arousal threshold to an intermittent pure tone. The placebo groups' highest mean arousal threshold was 70-75db SPL, compared to 100-110db SPL threshold values for the hypnotic group. The increase in arousal threshold occurred during the first hours of sleep, reaching a peak around 120-150 minutes post-ingestion. Return to sleep was also more rapid in medicated subjects, and the reduction in sleep latency followed the same time course as did the change in arousal threshold. Arousal threshold and sleep latency did not differ between drug and placebo groups after 3 hours post-administration.

The short acting benzodiazepine, triazolam, and flurazepam with its long acting metabolite did not differ in the magnitude of the elevation of arousal threshold, time course of effects across the night, or type of change over nights of consecutive use.

ELECTROPHYSIOLOGICAL AND CARDIOVASCULAR RESPONSES TO NOISE DURING SLEEP. EFFECTS OF A BENZODIAZEPINE HYPNOTIC.

Muzet, A., Weber, L.D., Amoros, C., Ehrhart, J., Libert, J.P., and Tsakona, C.

Groupe de Physiologie Environnementale, Centre d'Etudes Bioclimatiques du CNRS, 21 Rue Becquerel, 67087 Strasbourg-Cédex, France.

SUMMARY

Many people who estime their sleep as noise disturbed tend to remedy this problem by consumming various seditive hypnotics. In light of this, we decided to study the possible modifications of electrophysiological and cardiovascular responses to noise during sleep, when under the influence of such a substance.

24 young male subjects spent 7 nights in the sleep lab (NO-N6) all of which were consecutive with the exception of NO, which was a screening night. For all subjects, N1 and N2 were reference nights ; and NO, N3 and N5 were disturbed by semi-randomly distributed airplane noises (67 to 73 db) at a rate of 4 noises per hour.

Subjects were divided into 3 groups of 8. In a double blind design, Group A (control group) received a placebo, Group B received 0.25 mg of TRIAZOLAM and Group C received 0.50 mg of the same. TRIAZOLAM was administred to Group B and C, during N3, N4 and N5. The placebo was received during the remaining nights.

Results showed that for the control group, as would be expected, there were no significant differences between the 3 noise-disturbed nights. However, the 0.50 mg doses of TRIAZOLAM administred to Group C significantly decreased the number of noise provoked sleep stage changes and the number of noise provoked EEG awakenings. In addition, for this same group, there was a significant decrease in heart rate and finger pulse amplitude responses during N3 when compared to NO and N5. Although the same types of drug induced effects were present in Group B (0.25 mg), the differences between nights did not reach the statistically significant level.

In conclusion, TRIAZOLAM had marked effects on both electrophysiological and cardiovascular responses to noise during sleep, and these effects were dose dependent.

EFFECT OF INTERMITTENT AND CONTINUOUS TRAFFIC NOISE ON VARIOUS SLEEP CHARACTERISTICS AND THEIR ADAPTATION.

Thiessen, G.J.

National Research Council of Canada, Ottawa, Ontario, Canada

SUMMARY

It is clear that intermittent sounds of various kinds affect sleep either by shifting sleep to a shallower level or to awaken the subjects. The shorter the duration of the sound the less probable is this disturbance and the lower is the threshold. However this effect of duration does not extend to continuous noise which appears to be considerably less disturbing. In fact, at 47 and 60 dB, continuous traffic noise increases the percentage of "deep" sleep when that is defined to include all sleep in which spindles occur (stages 2, 3 and 4).

Latency of sleep onset for the average subject is not affected by continuous road traffic noise but for individuals it may be increased or decreased. Laboratory sleeping has a considerable effect on latency increasing it by about 10 to 15 min. for the first two nights and stabilizing to a constant value after eight to ten days. This laboratory effect is also great for the waking reaction which has a similar time for adaptation.

The cyclical nature of sleep may be affected for some individuals but for most this depends on how we define a cycle.

Habituation is only slight, and possibly zero, for the shift in sleep level for nearly all noises. But the waking reaction is reduced to about half value in about two weeks and is not sensitive to a change from 7 to 20 in the number of intermittent noises presented. However, existing data have not taken into account the laboratory effect.

The relation of all these effects to health is a much more difficult problem to sort out than the actual measurable reactions which are normally studied.

Poster Session

DAYTIME NOISE STRESS AND SUBSEQUENT NIGHT SLEEP: INTERFERENCE WITH SLEEP PATTERNS, ENDOCRINE FUNCTIONS AND SEROTONERGIC SYSTEM.

Fruhstorfer, B., Fruhstorfer, H., Grass, P., Milerski, H.G., Sturm, G., Wesemann, W. and Wiesel, D.

Institute of Physiology, Department of Gynecology and Obstetrics, Department of Neurochemistry, University of Marburg, Marburg, FRG.

SUMMARY

The aim of this study was to investigate whether strong daytime noise may effect restorative processes during subsequent night sleep. For this purpose 6 male volunteers (24-28 years) slept for 7 consecutive nights in the laboratory: 2 nights for adaptation, 4 nights after staying 8 hours per day in an experimental room where they were exposed for 2 days to 83 dB(A) pink noise, and finally one baseline night. Throughout all nights EEG, EOG, EMG, ECG and respiration were continuously recorded. Before the second night a catheter was inserted from an antecubital vein into the axillary or subclavian vein where it remained for 5 nights. During these nights blood samples were taken for the determination of ACTH, HGH, PRL, TRY, 5-HT and 5-HIAA. The results suggest that during the nights following noise stimulation the central nervous system has an increased demand for restorative processes.

AIRPLANE NOISES DURING SLEEP : EFFECTS ON BODY TEMPERATURE

Libert, J.P., Muzet, A., Amoros, C., Weber, L., and Ehrhart, J.

Groupe de Physiologie Environnementale, Centre d'Etudes Bioclimatiques du CNRS, 21 Rue Becquerel, 67087 Strasbourg-Cédex, France.

SUMMARY

The influence of airplane noises on body temperature was examined in 8 male subjects who spent 6 consecutive nights in the laboratory. The third and fifth nights were disturbed by semi-randomly distributed airplane noises, whose peak-intensities ranged from 67 to 73 dB, at a rate of 4 noises per hour.

Air and wall temperatures (T_o = 20°C) as well as air humidity (T_{dp} = 10°C) were kept constant throughout the experiment. Mean skin temperature ($\bar{T}_{sk}$) was calculated from 4 local skin temperatures using the area weighting factors of Ramanathan. Average all night body heat storage was calculated from an equation taking into account $\bar{T}_{sk}$, the rectal temperature (T_{re}) and the body mass of the subject.

Compared to the second baseline night, results showed significant increases of body heat storages on the two noise-disturbed nights. These increases can only be explained by T_{re} increases as $\bar{T}_{sk}$ was not modified.

COMPARISON OF THE IMPACT OF RAILWAY NOISE AND ROAD TRAFFIC ON SLEEP.

Vernet, M. - Simmonet, F.

Institut de Recherche des Transports, CERNE, Lyon, France.

SUMMARY

Sleep disturbance by train and road noises was studied at home on two groups of people submitted to both types of exposure. The effects of night Leq, peak level, duration, number of events, emerging from back ground noise, were observed in the physiological recordings and regrouped in : nil responses, transitory responses, stage changes, awakenings.

For the same value of night Leq, there were many more disturbances for the road traffic than for the railway traffic. However, this was not because people become more accustomed to train noise, but rather because such disturbances are closely related to the number of noise occurences, and there were many more road events than train events for the same overall Leq.

Sabato 25 giugno 1983 - ore 9,00
Saturday, June 25, 1983 - 9,00 a.m.

Gruppo di Studio n. 6
Team No. 6

Collettività cittadina e rumore
Community Response to Noise

Chairman: P.N. Borsky (U.S.A.)
CoChairman: R. Rylander (Sweden)

Sabato 25 giugno 1983 - ore 14,30
Saturday, June 25, 1983 - 2,30 p.m.

Invited Papers

HUMAN RESPONSE TO AIRCRAFT AND OTHER NOISE EVENTS

Stephens, David G. and Powell, Clemans A.

NASA Langley Research Center, Hampton, Virginia, USA

SUMMARY

Considerable progress has been made in understanding the efficacy of various metrics for quantifying the noise associated with a discrete, single source noise event such as an aircraft flyover. This type of information is essential to effective noise reduction efforts and/or equitable noise certification. However, differences in response are noted between sources which are not accounted for by metrics. This suggests that better metrics or the use of existing metrics in more sophisticated models will be required for the accurate prediction of human response particularly in cases where multiple sources are encountered.

EEC JOINT RESEARCH ON ANNOYANCE DUE TO IMPULSIVE SOUNDS: LABORATORY STUDIES

Rice,C.G.

Institute of Sound and Vibration Research, Southampton University, England.

SUMMARY

In their Third Environmental Research Programme for 1982/3 the Commission of the European Communities initiated and, together with participating member countries, partially funded laboratory and field researches on annoyance due to impulsive sounds. There were two principal research coordinators: C.G. Rice (United Kingdom) for the LABORATORY GROUP and R. de Jong (Nederland) for the FIELD GROUP. The overall programme was monitored by P. Guillot of the CEC, Brussells.

The laboratory and field groups held several joint planning meetings throughout the course of the project in order to ensure compatibility of results wherever possible. However, as each group had very different constraints placed upon it by the very nature of the studies involved, the research protocols and experimental design were obviously different.

This paper describes the findings of the laboratory group which was made up of team leaders from the following five countries:

Bundesrepublic Deutschland. Institut für Lärmschutz, Düsseldorf. (E. BUCHTA)
Denmark. Technical University of Denmark, Lyngby. (O.J. PEDERSEN)
Italia. Istituto di Audiologia, Torino. (G. ROSSI)
Nederland. I.Z.F.-TNO, Soesterberg. (J. VOS)
United Kingdom. ISVR, Southampton. (C.G. RICE)

The findings indicated that for sounds heard in isolation and at the same equivalent continuous sound level, impulsive noise is more annoying than traffic noise. The impulsive noise correction is level dependent and decreases from just under 10 dB at an indoor listening level of 35 L_{Aeq} to 0 dB at an L_{Aeq} of 70 dB.

When heard in combination, however, the annoyance responses are

confounded by the way in which the question is asked, as well as by the relative levels of the noises in question. *Source-specific* annoyance to impulsive noise is either heightened or depressed depending upon whether it is heard in a low or high traffic background. Furthermore, in a low background, *source-specific* annoyance is surprisingly greater than *total* annoyance, whereas in a high background *total* annoyance appears to be the subjectively corrected sum of the separate source contributions. *Total* annoyance does not correlate with total L_{Aeq}, and the latter's use as a unifying *scale* of noise measurement is not substantiated.

COMPARISON OF NOISINESS FUNCTIONS FROM DIFFERENT NOISE SOURCES METHODOLOGICAL PROBLEMS AND SUBSTANTIVE RESULTS

Bernd Rohrmann

University of Mannheim, SFB 24, Federal Republic of Germany

SUMMARY.

This contribution deals with the quantification of 'noisiness' differences between environmental noise sources. The definition of statistical noisiness functions and a procedure for quantitative comparisons are discussed. Then some empirical results from various field studies and principal determinants of noisiness are briefly summarized. Finally the need for improved research designs is emphasized.

RELIABILITY AND VALIDITY OF REACTION VARIABLES IN COMMUNITY NOISE RESEARCH.

Bullen, R.B. and Hede, A.J.

National Acoustic Laboratories, Sydney, Australia.

SUMMARY

Noise reaction - a person's feeling of displeasure or dissatisfaction caused by environmental noise - is typically assessed in a social survey with a single question concerning the respondent's "annoyance". Using the results of two separate social surveys conducted by the authors, responses to such questions are shown to be subject to a considerable amount of random error. This is not critical in determining the form of the dose-response curve, but can be important in other, more complex forms of analysis. The reliability of the reaction measure can be substantially improved by using a weighted sum of responses to a number of questions. In this process, the validity of the measure is also marginally improved.

When the reaction measure is a binary variable - for example, whether or not the respondent is "highly annoyed" - it is necessary to investigate the meaning of the level of reaction corresponding to the "high reaction" threshold. The usual threshold - defined by the point at which a respondent describes himself as "highly annoyed" on a verbal scale - appears to represent a higher level of reaction than is generally realised. It is argued that a lower threshold level results in a measure which corresponds more closely with the requirements of administrators, planners, prospective residents, etc. who will ultimately need to interpret the dose-response function.

PATTERNS OF BEHAVIOUR IN DWELLINGS EXPOSED TO ROAD TRAFFIC NOISE

LAMBERT,J. - SIMONNET,F. - VALLET,M.

IRT-CERNE, BRON, France

SUMMARY

An inquiry involving a total of 1500 subjects residing in 15 different sites in the conurbations of Lyon and Marseilles was carried out in 1979 with a view to determining the behaviour and attitudes of people with regard to traffic noise. The main purpose of the inquiry was to identify the objective reactions to the traffic noise and to determine how such reactions varied with the noise level on taking account of the socio-economic characteristics of the subjects (age, income, owner occupier or tenant, etc.).

The 08.00 to 20.00 hour Leq noise level was measured or calculated for each of the dwellings included in the inquiry. The 00.00 to 05.00 and 20.00 to 24.00 hour Leq values were also derived for each case and a total of nearly 20,000 different noise levels were involved in the analysis of the data for this inquiry.

On considering the completed questionnaires it was found that the annoyance experienced during the day was more closely correlated with the noise level ($r = 0.64$) than had been the case with the results of previous studies.

In addition to showing how traffic noise can interfere with activities and lead, for example, to the closing of windows to shut out the noise, the inquiry yielded information on the way in which activities affected by noise are transferred to quieter rooms, on the extent to which individual dwellings are sound proofed, on the extent to which occupants are likely to move to another dwelling in order to escape from the noise and finally on some aspects of the effects of noise on health and sleep.

Thus it appears that a daytime Leq value of more than 65 dB(A) gives rise to what can be regarded as forced behavioural responses to the extent that there are significant changes in the normal way of life of the people concerned and such responses give an indication of the magnitude of the social costs that can be attributed to the undesirable effects of traffic noise.

Poster Session

REACTION TO AIRCRAFT NOISE NEAR GENERAL AVIATION AIRFIELDS

Brooker, P. and Davies, L.I.C.

Civil Aviation Authority, London, UK.

SUMMARY

A study of annoyance reaction to aircraft noise around five General Aviation (GA) airfields in the United Kingdom is described. The study was undertaken because doubt had been expressed about the use of Noise and Number Index (NNI) as a measure of community annoyance around GA airfields. The study consisted of social survey allied to noise measurement in one area near each of the five airfields. The results showed that respondents' scores on the Guttman Annoyance Scale (GAS) was an adequate measure of annoyance for GA airfields and was well correlated with NNI above a level of 30 NNI: above 35 NNI the responses to GA were more marked than in areas of comparable exposure around Heathrow Airport. It was not possible to determine if any other index would perform markedly better than NNI above the level 30-35 NNI, because NNI, Leq, Logarithmic average noise level and number of movements were highly correlated.

A CROSS-CULTURAL STUDY OF NOISE ANNOYANCE: A COMPARISON BETWEEN BRITAIN GERMANY AND JAPAN.

Thomas, J.R., Namba, S*., Schick, S#., and Kuwano, S*.

Department of Psychology, University of Warwick, Coventry CV4 7AL England.
* Department of Psychology, Osaka University, Osaka 560, Japan
# Department of Psychology, Universitat Oldenburg, 2900 Oldenburg, W. Germany.

SUMMARY

A cross-cultural study of perspectives and attitudes associated with noise was carried out between England, Germany and Japan. The study looks at attitudes towards noise, and the acceptability of various forms of noise countermeasures In addition an attempt was made, using semantic differentials, to obtain information on the differences between the various cultures, in the meanings, of such key concepts in noise research as "noise", "loudness" and "annoyance"

The results indicate differences in the attitudes and acceptability of countermeasures to noise between the countries. Although the semantic differential profiles were similar for "noise" and "annoyance", the concept of "loudness" was considerably different for the Japanese sample.

It is therefore important to bear in mind the existence of such differences when comparing results across countries.

TAKING ACCOUNT OF CUMULATIVE ASPECTS IN NOISE ABATEMENT POLICY-SOME PRELIMINARY REMARKS.

ir M van den Berg

Ministry of Housing,Physical planning and Environment,Leischendam,Holland.

SUMMARY

There is a certain need for a convenient method which describes with one or a few items the acoustic quality of,for example a building location.Two possible ways are described to come to such a descriptor.

The first one is based on the finding that noise events become more annoying(and presumably more damaging) if they are of higher peak level and if they occur more often.This results in a method that corrects the overall equivalent sound level for the number of events according to their respective peak levels.

The second method is based on the assumption that the effects can be in some way added to give the overall effect.This method uses dimensionless indices in which the source specificity has been accounted for,after which they can be 'added'.

ANNOYANCE RATINGS FOR IMPULSE AND TRAFFIC SOUNDS IN BACKGROUND NOISE

Vos, Joos and Smoorenburg, Guido F.

Institute for Perception TNO, Soesterberg, The Netherlands.

SUMMARY

From the annoyance ratings, determined in this study, impulse noise correction factors, C_{imp}, were derived. In particular, it was the aim to investigate to which extent these penalties are dependent on (1) the type of the impulse noise, (2) the level of the noise, (3) the level of the background noise, and (4) whether there is asked to rate the annoyance from specific sources or from the total noise. For source-specific annoyance at both a low and a high background noise level, and for total annoyance at a low background noise level, C_{imp} for gunfire noise is level dependent and decreases from about 12 dB at a level of 35 L_{Aeq} to about 6 dB at an L_{Aeq} of 65 dB. For similar conditions, C_{imp} for metal construction noise is lower and tends to be level independent. The need for penalties at higher levels has also been found for total annoyance ratings at a high background noise level.

Mercoledì 22 giugno 1983 - ore 16,15
Wednesday, June 22, 1983 - 4,15 p.m.

Gruppo di Studio n. 7
Team No. 7

Gli animali ed il rumore
Noise and Animals

Chairman: R.G. Busnel (France)
CoChairman: J.L. Flechter (U.S.A.)

Invited Papers

SOME CARDIOVASCULAR AND BEHAVIORAL EFFECTS OF NOISE IN MONKEYS.

Peterson, E. A., Augenstein, J. S., Tanis, D. C., Warner, R., and Heal, A.

University of Miami, School of Medicine, Miami, Florida, U.S.A.

SUMMARY

Five long-term experiments are described. Their results point to a possible causal relationship between noise and cardiovascular function. Twenty chair restrained macaque monkeys were observed over periods ranging from 9 to 15 months. Experimental animals were exposed to moderate levels of realistic noise after baseline norms had been established for them. Compared to control responses or their own baseline ones, experimental animals consistently manifested significant and sustained elevations (27%-30%) in blood pressure which did not disappear after the noise ended. Beyond this fundamental result, we have found that more subtle changes occurred in the presence of noise, including those in the diurnal rhythm of blood pressure and the beat- by-beat distribution of heart rate values. We also observed that the protracted blood pressure increases may have been maintained by increased peripheral vascular resistance rather than by increased output from the heart and that allowing some stimulus control may reduce noise effects.

Contradictory findings reported in the animal-model literature may be the result of an interaction between methodological or species differences and the inherent complexity of noise-induced health effects.

THE NON-AUDITORY EFFECTS OF NOISE ON THE BABOON.

Turkkan, J.S., Hienz, R.D. and Harris, A.H.

Department of Psychiatry and Behavioral Sciences, The Johns Hopkins University School of Medicine, Baltimore, Maryland

SUMMARY

The results of the present study indicate that exposure to realistic levels of industrial noise produce acute increases in pressure and heart rate within the first minute after noise onset. The acute noise exposure effects appeared to be related to the magnitude of the noise intensity, being observed during the first day at 97 dBA, not present on day 1 at 83 dBA, and appearing gradually over the first week at 83 dBA. Further, a dose-effect relationship was demonstrated between noise intensity and diastolic pressure increase for the first week at 83, 93, and 97 dBA. The time course of habituation of acute cardiovascular effects appeared to be inversely related to noise intensity. These data lend support to the suggestions of others (e.g., Borg and Moller, 1978) that organisms may habituate to at least some of the long-term effects of noise exposure.

The chronic noise-induced decreases in blood pressure, heart rate, and catecholamines have little parallel in the literature, where the vast majority of both human and animal studies have shown either no change (e.g., Malchaire and Mullier, 1979; Borg and Moller, 1978) or increases in cardiovascular and hormonal levels (Hattis and Richardson, 1980). It has

been suggested, however, that younger humans may respond to chronic noise with a lowering of blood pressure (Welch, cited in Hattis and Richardson, 1980). The use of sub-adult baboons in the present study is suggestive in this connection, and may account for the differences in cardiovascular effect between the present study and the similar study of Peterson et al. who used relatively old (5-8 year old) rhesus monkeys.

Significant correlations between plasma norepinephrine and blood pressure level have been previously reported in baboons (Goldstein, Harris, Izzo, Turkkan and Keiser, 1981). In this study as well, plasma norepinephrine and epinephrine were decreased in conjunction with blood pressure decreases, pointing to an overall decrease in adrenergic activity (and a possible increase in vagal tone, as suggested by the correlated lowering of heart rate levels). A recent study (Andren, Hansson, Bjorkman, and Jonsson, 1980) indicates a more inotropic than chronotropic influence of noise in that significant decreases in stroke volume and cardiac output were obtained in the absence of significant change in heart rate in human subjects (26 years old) exposed to 95 dBA noise.

Because anticipatory blood pressure and heart rate increases were apparent prior to feeding times, meal times were manipulated in Baboon MI to examine the possibility that food-induced cardiovascular changes were masking the noise onset and offset effects. When morning feeding was eliminated (total daily food was kept constant), noise onset resulted in an acute blood pressure decrease, suggesting that the hypotensive effects of noise may be heightened by careful consideration of noise exposure times in relation to feeding times. The possibility also exists that noise assumed the properties of a conditional stimulus (CS) for food, resulting from the daily regularity of the noise onset - food presentation

interval. Acute blood pressure increases as conditional responses to food-related stimuli have been reported previously in the monkey (Billman, Hasson, and Randall, 1978). The notion that an extremely intense stimulus such as noise cannot act as a CS is contradicted by the counterconditioning literature where it has been shown, for example, that an intense electric shock results in salivation in dogs when shock regularly predicts food (Frolov, cited by Pavlov, 1927). Thus, the acute blood pressure increases observed during the noise onset - food presentation interval may have been conditioned responses, a suggestion strengthened by the finding that when food was eliminated, the pressure increases during that interval were also eliminated.

In all, these studies point to a more complex effect of noise on the cardiovascular and hormonal systems than has been hitherto suggested. Although the amount of controlled animal experimentation in this area is growing, many aspects of the non-auditory effects of noise remain to be clearly delineated.

PRINCIPLES FOR DRAFTING AND ENFORCING LEGISLATION TO PROTECT WILDLIFE FROM ENVIRONMENTAL NOISE

Luz, G.A.

U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland, USA

SUMMARY

There are four important questions to be asked when drafting laws to protect wildlife areas from noise:

1. How loud (or annoying) is the noise to the species of interest?
2. Does the noise, per se, pose a threat to the species of interest?
3. Can the species adapt to the noise without adverse physiological consequences?
4. How can the law be enforced with the resources available?

Through review of selected environmental impact studies from the USA and of the more general literature on the effects of noise on wildlife, the principles involved in the first three questions are explored. An illustrative solution to the fourth question using a modified commercial noise dosimeter also serves as an "electronic summary" of the first three questions.

Sabato 25 giugno 1983 - ore 14,30
Saturday, June 25, 1983 - 2,30 p.m.

Sessione Conclusiva
Closing Session

La riduzione del rumore ed il suo costo
Noise Reduction and Costs

Chairman: H.v. Gierke (U.S.A.)

Closing Session

NOISE ABATEMENT TODAY AND TOMORROW.

Alexandre, A. and Barde, J.-Ph.*

Environment Directorate, OECD, Paris, France

SUMMARY

If we want to avoid that the title of this paper means in fact "noise today and abatement ... tomorrow", three actions must be undertaken: (i) comprehensive forecasts of the future noise environment - including changes in life styles which are taking place -; (ii) the strengthening of noise emission limits must be pursued but it should be recognised that this strategy will not be sufficient; (iii) all kinds of incentives should be adopted in order to adjust the noise abatement policy to the present economic situation as well as to the need for a noise climate that would not only be just acceptable, but really comfortable.

NOISE CONTROL, ITS COSTS AND BENEFITS

Vogel, Ansgar O.

Federal Ministry of the Interior, Bonn, Germany

SUMMARY

- Noise control is a political task of great significance, especially in modern industrial societies.
- As the example of the Federal Republic of Germany shows, great efforts have been untertaken in recent years at considerable expense to diminish noise exposure.
- Although no satisfactory method of carrying out a cost/benefit analysis of noise control has yet been devised, useful and practicable beginnings in fact have been made in this direction. Parameters considered in the cost/benefit calculation that cannot (yet) be quantified must not be neglected. They should be introduced into the weighing process as unquantified but relevant factors.
- Noise control should start at the source. Here it is most effective. The first step often is relatively cheap, whereas the following steps are becoming increasingly more expensive.
- Measures at source cannot guarantee adequate noise control. The economically reasonable solution is a combination of various measures at source, during sound transmission, and at the place of exposure, adapted to the requirements of the individual case.
- There exists a particualarly favorable cost/benefit ratio in educating the people to handle their motor vehicles more carefully.