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Oral

1. Noise-induced hearing loss

28330 - Hearing problems among members of the defence forces in relation to personal and occupational risk factors

1. Noise-induced hearing loss
Keywords: hearing loss, military service, audiometry
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Hearing loss (HL) is a major health concern among military personnel. Two cross-sectional studies among military service members were carried out. First, altogether 807 respondents completed a questionnaire about their health, personal and work-related risk factors in indoor and outdoor environments. Later, 150 military personnel filled in detailed noise exposure questionnaire and went through audiometric test.

Results showed that the most important risk factors predicting hearing loss in the military were age, gender and service duration. Also, working in a noisy environment, exposure to technological, vehicle, and impulse noise as well as exposure to chemicals and high stress score showed a statistically significant effect on hearing health. The prevalence of mild to severe HL in high frequencies (4 and 6 kHz) among study participants was 62.7%. Nevertheless, majority of it was mild, as prevalence of severe HL was 9.3%. Risk ratios for HL were higher among those working in noisy environment, working with noise-producing equipment, driving PASI/Bandvagn or frequently shooting with blanks. HL was more common among those never using personal protective equipment.

28662 - The use of personal listening and IT devices in the risk behavioral survey

1. Noise-induced hearing loss
Keywords: behavioral survey, high school students, personal listening devices, IT devices, abuses
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The study evaluates the impact of selected behavioral, psychological and socioeconomic factors on adolescent health in Bratislava, Slovakia. Special attention is paid to the use of selected IT devices (TV, PC, personal music players - PMP). The data from 525 students (185 boys) attending 8 secondary schools, aged 15-20 years are presented. 90.9 % of students listen to PMP on average 405 minutes and use mobile phone 384 minutes per week, significantly more girls. About 50 % of students are listening to PMP more than 200 minutes a week. Those students smoke, drink alcohol, use drugs significantly more than students listening to PMP less than 200 minutes a week. The tinnitus is manifested as well. The high percentage of PC usage has been observed, especially during the weekend (72.1% more than three hours per day), and less interest in watching TV. The study presents a challenge for analysis and future prevention as well as intervention activities to protect and promote the health of children and youth.

28731 - Exposure to recreational music among Indian youth: An exploratory study

1. Noise-induced hearing loss
Keywords: Recreational music, Youth, India
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Background
Exposure to recreational music among young people is becoming increasingly common in India. This study was planned to determine the loud music listening habits and awareness about its deleterious effects among youth in India.

Materials and methods
A cross sectional survey was conducted in randomly selected higher school and college students around national capital of Delhi. Data was collected using a semi-structured interview schedule having details of demography, music listening habits and knowledge regarding the hazardous effects.

Results
A total of 480 participants were included in the study; out of which 99% were listening to loud music on mobiles, laptops and music systems. Among those who were music listeners, 89% reported frequent (>5 days in a week) exposure to loud music. 76% reported liking for loud music in social gatherings. Less than half of the participants were aware about any auditory or non-auditory effect of loud music. Most common after-effects of loud music were headache and ringing sensation in the ears.

Conclusion
There is an urgent need of generating awareness among youth regarding hazards of loud recreational music.

28880 - Occupation noise induced hearing loss in India: A systematic review and meta-analysis

1. Noise-induced hearing loss
Keywords: Noise induced hearing loss; Occupational hearing loss; Earplugs; Informal workers; India
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Background

India has over 50 million workers employed in industries with exposure to very high sound pressure levels, predisposing them to noise induced hearing loss (NIHL).

Methods

We conducted a systematic review and meta-analysis using the following criteria: (1) Observational or experimental studies conducted in India (2) English language (2). Published during January 2010 - December 2019 (3). Outcome: proportion of participants detected with NIHL. We reviewed bibliographic databases (PubMed/MEDLINE, Scopus, DOAJ, Google Scholar) and extracted relevant data.

Results

A total of 93 records were screened after removing duplicates and 32 studies were included in the systematic review. Duration of employment was the most important risk factor for hearing impairment. The prevalence of NIHL varied from 6% to 100% with higher risk in workers of informal industries. Average ambient noise level varied from 77.5-95 dB. Most studies didn't report protective earplug usage by the workers in terms of availability, awareness and adherence. Only 1 study design was prospective which differentiated between temporary and permanent threshold shift.

Conclusion

NIHL is a major neglected and avoidable public health problem in various Indian industries.

28909 - Children and Sound Amplification

1. Noise-induced hearing loss
Keywords: Children, noise, hearing loss, hearing test
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People regularly exposed to excessive noise levels, at events such as concerts, dance competitions, and at the movies (loud events using sound reinforcement), are at risk regarding permanent hearing loss. Among these people, children are especially at high risk because their personal autonomy is limits. They have to be protected by society. At present, there is no special regulation to protect children's hearing in Hungary and in many other European countries. To change this status an expert group was formed. A series of investigations were carried out to determine the noise exposure of various children's events (25 tests). Hearing tests were completed occasionally (with 48 children) before and after the events, to evaluate the casual short term changes in the ear. Based on the literature, noise limitations were introduced to protect the hearing of children participating in sound reinforced events. The noise measurement results were then evaluated according to the introduced noise limitations, showing an agreement with objective and subjective hearing test results. The work, presented in this article, is intended to change the event organisation and audience customs.

28915 - Temporal alterations to central auditory processing without synaptopathy after lifetime exposure to environmental noise

1. Noise-induced hearing loss
Keywords: Auditory Cortex, Environmental noise, Maturation, aging, synaptopathy
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People are increasingly exposed to environmental noise, through the cumulation of occupational and recreational activities, which is considered harmless to the auditory system if sound intensity remains <80 dB. However, recent evidence of noise-induced peripheral synaptic damage and central reorganizations in the auditory cortex despite normal audiometry results have cast doubt on the innocuousness of lifetime exposure to environmental noise. We addressed this issue, by exposing adult rats to realistic and non-traumatic environmental noise up to 18 months. We found that temporary hearing loss could develop daily, over months of exposure, without necessarily leading to permanent hearing loss or to missing synaptic ribbons in cochlear hair cells. The degraded temporal representation of sounds in the auditory cortex after lifetime exposure was very different from the effects observed after only three months of exposure, suggesting that modifications to the neural code continue throughout a lifetime of exposure to noise.

28943 - Hearing-related symptoms and occupational noise exposure among women: An intervention study in preschool and obstetrics care

1. Noise-induced hearing loss
Keywords: hearing, occupational noise, intervention, prevention
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Recent cross-sectional studies have showed that preschool teachers and obstetrics personnel risk developing hearing-related symptoms associated with noise exposure. An ongoing cohort follow-up and intervention study will provide causal interpretations and evaluation of preventive factors.

This presentation will include an overview of the project with focus on the intervention study, assessing effects on self-reported noise exposure and hearing-related symptoms. The intervention was performed at one preschool and one obstetrics care unit with two control workplaces each.

A participatory approach was used, involving personnel, managers and health and safety representatives. The process followed a common structure in identifying, selecting, implementing and evaluating the interventions, whereas the interventions were tailored to each workplace. Survey data was collected at baseline and two follow-ups, and analysed using generalised estimating equation (GEE).

We did not find significant positive effects of the intervention. Factors such as limited resources for implementation and other work environment deteriorations probably explain some of the negative results. Meanwhile, qualitative data indicated positive experiences of the interventions. Thus, we suggest further studies with control of implementation and other changes in the workplace.

28987 - Noise-induced hearing loss: a three-year update

1. Noise-induced hearing loss
Keywords: Noise-induced hearing loss, NIHL, review
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Noise-induced hearing loss is the second major cause of hearing loss (after presbyacusis; age) and therefore noise exposure is the main modifiable risk factor for hearing loss. From 2017 to 2019, 783 journal articles were published with the keywords noise-induced hearing loss or NIHL (listed on Web of Science). The number was similar to the previous three-year period (2014-2016; N=830). The main areas in which they were published were neurosciences (574), otorhinolaryngology (536), audiology (289), public/environmental/occupational health (278), psychology (214), and behavioural sciences (195). A key area for research continues to be the study of cochlear synaptopathy and so-called 'hidden' hearing loss, or difficulty hearing in noisy environments alongside relatively normal ability to hear in quiet. Other investigations were designed to evaluate the prevalence of NIHL in different populations; to assess the role of individual risk factors for NIHL, including genetics, to develop new strategies for preventing acoustic traumas (diet, pharmacological intervention); to investigate effects at work or in non-work activities (especially amplified music) and to assess the effectiveness of hearing loss preventive campaigns.

29030 - Hearing damage among musicians in symphonic orchestras

1. Noise-induced hearing loss
Keywords: Musicians, hearing loss, hearing monitoring
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Many studies have looked at the sound exposure of symphony orchestra musicians and on their hearing thresholds. There seems to be a consensus that the sound exposure is high and, in most cases, exceed recommended occupational noise limits. On a group level these musicians seem to have better than average hearing, and better than what could be expected based on an assessment according to the standard ISO 1999. However, typical dips in the hearing threshold consistent with a noise-induced damage, have frequently been observed.

Effective measures to reduce the exposure and hence reduce the risk of hearing damage are not readily available, and if the musicians on a group level have better hearing than normal these measures might be unnecessary. This presentation will show how an individually based hearing monitoring system can be used to reduce the risk of being damaged, and that such system can be used to detect the noise sensitive individuals to implement more effective countermeasures.

33397 - A smartphone application to objectively monitor music listening habits in adolescents

1. Noise-induced hearing loss
Keywords: Listening device, noise, music induced hearing loss, behavior, adolescents
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Objectives
There has been a substantial increase in the popularity of personal listening devices (PLDs), especially among young people. The aim of this study was to monitor listening habits with a smartphone application, and to examine whether adolescents exceed recommended noise exposure limits when using PLDs.

Methods
This study was embedded in the Generation R Study, a population-based prospective birth cohort in Rotterdam, the Netherlands. A smartphone application was developed to objectively measure PLD use for a period of 35 days.

Results
Among the 314 adolescents included, the median number of days listening a week was 2.4 (IQR, 1.0-3.3) and median listening time 20.2 minutes a day (IQR, 8.8-50.8). The mean listening level was 55.0% (SD, 17.9%). Within the study group, 2.2% adolescents exceeded the recommended daily noise dose (85 dBA as an 8-hour time-weighted average) considering all days the application was active, and 9.8% when only considering listening days.

Conclusions
Results confirm the feasibility of monitoring listening habits by a smartphone application. The majority of adolescents exhibited listening habits that could be considered as safe.

33807 - Leisure noise exposure and associated health-risk behavior in adolescents

1. Noise-induced hearing loss
Keywords: Leisure noise, adolescents
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Adolescents engage regularly in noisy leisure activities, which could lead to noise-induced hearing damage. The aim of the study was to evaluate the attendance, duration and estimation of loudness during various leisure noise activities, as well as the presence of hearing-relating symptoms. In addition, attitudes and beliefs toward noise, hearing loss and hearing protector devices were investigated using the Dutch version of the Youth Attitude to Noise Scale and the Beliefs About Hearing Protectors and Hearing Loss questionnaire. Subjects between 15 and 20 years of age were questioned, of which 247 adolescents (33.3% males and 66.7% females) were included in the study. Tinnitus after noisy leisure activities was frequently reported. In general, noise was not considered as problematic, and the use of hearing protectors devices as not important, while the subjects were concerned about the consequences of hearing loss. Nevertheless, the reported use of hearing protector devices in adolescents was limited. The results of the study will further be discussed on the 13th ICBEN Congress on Noise as a Public Health Problem.

33954 - Hearing Diagnostics – The variability in potential biomarkers for cochlear synaptopathy after recreational noise exposure

1. Noise-induced hearing loss

Keywords: Cochlear synaptopathy, suprathreshold auditory evoked potentials, speech-in-noise tests

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Objectives Speech-in-noise tests and suprathreshold auditory evoked potentials are promising biomarkers to diagnose cochlear synaptopathy (CS) in humans. This study investigated whether these biomarkers changed after recreational noise exposure.

Design The baseline auditory status of 19 normal hearing young adults was analyzed using questionnaires, pure-tone audiometry, speech-audiometry and auditory evoked potentials. Nineteen subjects attended a music festival and completed the same tests again at one, three and five days after the event.

Results No significant relations were found between lifetime noise-exposure-history and hearing tests. Changes in biomarkers from the first session to the follow-up sessions were non-significant, except for speech audiometry, that showed a significant training effect.

Conclusions Despite the individual variability in pre-festival biomarkers, we did not observe changes related to the noise-exposure dose caused by the event. This can indicate the absence of noise-exposure-driven CS in the study cohort, or reflect that biomarkers were not sensitive enough to detect mild CS. Future research includes a more diverse study cohort, dosimetry and results from test-retest reliability studies to provide more insight into the relationship between noise exposure and CS.

33955 - Comparison of self-reported questionnaires related to lifetime noise exposure

1. Noise-induced hearing loss
Keywords: Lifetime noise exposure, self reported questionnaires
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Background Noise exposure history is generally estimated by self-reported questionnaires. However, the accuracy of retrospective self-report might be limited by subject recall. A study in 2018 developed the Noise Exposure Structured Interview (NESI); an instrument for a comprehensive estimation of lifetime noise exposure. In this instrument, the subjects reporting is not restricted to prespecified activities. By dividing the lifespan into discrete periods in which exposure habits are assumed to be stable, it is possible to evaluate changes in exposure habits and the use of hearing protection over time. The goal of the this study was to compare the recent NESI with the questionnaire based on Jokitulppo et al. (2006) and currently used by our research group.
Design It is foreseen to include 150 subjects between 18 and 35 years old, whom will complete both questionnaires online with a time-interval of two weeks.
Results Data collection is ongoing and results will be presented during the 13th ICBEN 2021 Congress on Noise as a Public Health Problem.

33994 - Exploring the associations between hearing loss, hearing protection use, noise exposures, and injuries among mining workers

1. Noise-induced hearing loss
Keywords: noise-induced hearing loss, injuries, near-miss, occupational noise, mining
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This study evaluated the relationships between noise, hearing protection device (HPD) use, hearing loss (HL), and injuries among workers at 10 US mines. We used dosimeters to assess Time-Weighted Average (TWA) exposures. Participants completed a baseline survey and daily activity logs over their 3-day participation period. We also measured personal HPD attenuation and hearing threshold levels. Among 207 workers and 567 work-shifts, HPDs were worn on average 74% of the time, and exposures were high (mean TWA 85±6 dBA). Roughly 27% of workers had HL, and 42% reported tinnitus. HPD use time was positively associated with noise exposure. Workers with HL achieved significantly lower attenuation than those with normal hearing. Over the past year, approximately 20% of workers reported a near miss and 28% reported a work injury. Previous serious injury, sleepiness, and effort were significantly associated with increased near-miss risk, and HPD use, fatigue, and previous serious injury were associated with significantly elevated injury risk. Workers with HL should be prioritized for fit testing, and interventions to reduce injuries associated with hearing loss and HPD use are warranted.

34029 - Approaching to hearing health of Uruguayan academic musicians

1. Noise-induced hearing loss
Keywords: academic musicians hearing health, criteria for evaluating hearing loss, audiometric data base
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Within the framework of an interdisciplinary research, a first audiometric database of Uruguayan academic musicians (singers and orchestral musicians) was developed. Before performing a pure-tone audiometry on each of the musicians, an occupational physician conducted an interview (an anamnesis form with about 50 questions) and an otoscopy. Hearing loss was evaluated with two criteria: one preventive (mean loss at 2000 Hz and 4000 Hz) and the other reparative (mean loss at 500 Hz, 1000 Hz and 2000 Hz). Both values were included -one at a time- as components of a vector per participant, along with 31 other variables preselected from the anamnesis. Each set of 32 variables was reduced to a smaller one of 10 variables, by performing Principal Components Analyses (PCA). The final sets differed in 2 of the 10 variables: in the first case, the gender of the participant and the history of having had mumps mattered; while in the other one, social exposure to high sound pressure levels (hunting, discos, etc.) and the family's history of hearing damage did.

2. Noise and communication

28594 - Speech perception in noisy and reverberant conditions: does the listening effort change in presence of speech modifications/Lombard speech?

2. Noise and communication
Keywords: speech perception, Lombard speech, listening effort
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This study examines the effects of modifications of the speaker's spectrum (Lombard speech, LS) on a commonly used behavioral measure of listening effort (LE): the manual response time in a single-task paradigm (RT: time elapsed from the offset of the auditory stimulus to the response selection on a touch-screen). For this purpose, 76 young adults with normal hearing completed speech-in-noise tests, which were presented in three simulated listening situations (reverberation time: 0.65, 1.00, 1.54 s). In the last two conditions the speaker's spectrum was processed to mimic LS. Speech-like stationary and fluctuating noises were used as maskers, and a wide range of signal-to-noise ratios was explored. Based on the individual regression curves, values of RT for three fixed values of speech intelligibility (0.50, 0.75, 0.90) were obtained. It was found that the RTs did not change between conditions without and with LS at different reverberations, suggesting that LS was quite effective in controlling LE against reverberation. In addition, RTs were found to be similar or shorter for stationary compared to fluctuating noise, depending on the amount of reverberation.

28649 - Auditory processing evaluation of children with history of noise exposure.

2. Noise and communication
Keywords: Noise, Auditory processing, Children, Learning
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Noise exposure can be interfering in the auditory processing of children. The alterations on central auditory pathways can be verified even if there is no any alteration on peripheral hearing. There is a growing number of children with speech and language disorders who have difficulty learning to read and write and who need an accurate diagnosis so that they can develop their potential and achieve success in the learning process. The aim of this descriptive study was to propose an option to use existing tests and evaluations and protocols for the evaluation of these patients. Several evaluation modalities exist in order to direct the treatment, but many do not see the clinical picture in its entirety. The use of these tests is suggested: Simplified Auditory Processing Assessment (ASPA) and the Pediatric Speech Intelligibility Test (PSI). It is concluded that this alternative follow-up assessment is viable for the evaluation of central auditory processing in children at the elementary schools with history of noise exposure.

28694 - The effects of background noise, task difficulty and age on speech comprehension for 11- to 13-year old children

2. Noise and communication
Keywords: speech comprehension, children, noise, task difficulty
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This study aimed at investigating the effect of task difficulty on speech comprehension for middle-school students in reverberant classrooms with competing background noise. Normal hearing children aged 11 to 13 (N=171) having normo-typical development participated in the study. The comprehension task consisted in listening to sentences and selecting on a touchscreen the image that properly matched the sentence just heard. The test was administered collectively in the students' classroom in three listening conditions: quiet, traffic noise and babble noise mixed with typical classroom sound events. The task difficulty was manipulated by varying the syntactic complexity of the sentences. Data on both accuracy and response times were acquired, the latter informative on the allocation of mental resources during the task. Results suggest that sentences that are more difficult output both lower performance accuracy and longer response times. However, the presence of significant interactions between the independent variables also indicate that the effect of task difficulty is modulated by the type of background noise and by listener-centered factors (age).

28795 - Getting interior acoustics on the ’menu’ of restaurants

2. Noise and communication
Keywords: Restaurants, Acoustics, Noise, Annoyance, Health
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(introduction) The impact that bad indoor acoustics can have on a restaurant’s bottom line is documented in more and more studies. Still the Lombard effect is a severe problem in this industry. A 2018 survey shows that noise is now the number one complaint of diners. Nearly 80% of people have left a restaurant due to high noise levels. Last year another survey measured the highest noise level of 50 restaurants above 85 dB at each of them. While average noise levels of the five top-rated restaurants were between 75 - 83 dB. Maintaining the current aesthetic trend of hard surface floors, minimalistic interior and open kitchen, there are still ceiling and wall surfaces that can look monolithic and at the same time absorb.

(method) The presentation will focus on the latest room acoustic measurements in restaurants and diners feedback. This is then linked to the current status of acoustic requirements for restaurants in national building regulation and a hands on way forward of acoustic capacity calculations (number of seats in a restaurant) to still maintain a comfortable environment.

28958 - Psychoacoustic indicators of temporal perception of consonants' loudness

2. Noise and communication
Keywords: pulse, sequence of pulse, masking, indicators, speech perception,
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Auditory perception of consonants plays an important role in speech recognition. We looked for indicators of perception of consonants loudness that could characterize the individual properties of speech perception among listeners. Speech was formally represented by a periodic sequence of consonants, whose models were tonal pulses. The first or last pulse in sequence was test-pulse. Dependences of the percentage of correct detection of test-pulse (4kHz, 240Hz) on its intensity (0-80dB) for various T intervals (20-150ms) between pulses in the sequence were obtained. The masking pulses intensities were 80dB SPL. Minimum interval Tmin at which listeners could detect test-pulse was a temporal resolution threshold of pulse loudness. We also estimated the minimum (Imin) and maximum (Imax) intensities of test-pulses that could be detected by listener in presence of masking pulses with interval of Tmin, as well as the detection range (dI) as differences between Imax and Imin. The characteristics Tmin, dIso, dIsm, dI were compared with listeners' auditory sensitivities and their temporal summation properties. The characteristics Tmin, dIso, dIsm, dI could be indicators of the temporal perception of the consonants loudness.

29365 - Comparison of objective acoustic criteria and subjective impressions in modern offices

2. Noise and communication
Keywords: working areas
Eugen Fridlib

The modern office consists of different working areas - open space, separate rooms, conference rooms and event zones, small meeting rooms and «telephone booths». Features of the team and individual work, especially in creative industries, require maximum involvement in the process, and therefore a minimum number of distractions. This leads to increased requirements for soundproofing, reducing background noise and increasing speech intelligibility in meeting rooms. Acoustic requirements for the small meeting rooms with an area of fewer than 10 m2 are especially interesting in the context of their use for teleconferences. The subjective experience in operating such rooms shows that even if they comply with the recommended existing standards for acoustics, the real quality may be unsatisfactory. Also, we could see different types of partitions in offices - solid, glass, combined, which converge at one point. In this case, it is extremely important to ensure a correct connection to avoid flanking transmission of noise. In this report, we look at some successful and unsuccessful office solutions, analyze results of acoustic measurements compared to operating experience.

34016 - Effect of Sound Pressure Level and Frequency of Pure Tone on Elderly People's Reaction Time and Perceived Urgency

2. Noise and communication
Keywords: auditory warning signal, elderly, age-related hearing loss, reaction time, perceived urgency
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The warning sounds in aging-friendly communities should be specially designed to promote safety of elderly people considering the difference in the auditory ability between elderly and young people. This study aims at revealing the effect of different sound pressure levels and frequencies of pure tone on the elderly's reaction time and perceived urgency, and how they differ from the effect on young people. The results showed that increase of sound pressure level significantly shortened reaction time and promoted perceived urgency of the elderly. Frequency of pure tone had a significant impact on the elderly's reaction time, while it had no significant impact on young people's reaction time. At low sound pressure levels, the elderly's reaction time got shorter as the frequency increased from 125 Hz to 1000 Hz. However, the elderly stated that the highest perceived urgency was at 500 Hz, which was lower than that of young people (1000 Hz or 2000 Hz). The inconformity between response time and perceived urgency of pure tone implied that both of them should be considered in alarm design for elderly people.

3. Non-auditory health effects of noise

27791 - Aircraft noise health impacts and limitations in the current research

3. Non-auditory health effects of noise
Keywords: aircraft noise, health, study limitations
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Continuous growth of the aviation industry draws attention to the consideration of health effects associated with aircraft noise exposure. With this systematic literature review of aircraft noise health effects we wished to address the latest scientific findings and consider what type of limitations are present in the studies that could negatively impact the validity of the research findings. The literature screen was firstly implemented in June 2018 within the EU H2020 ANIMA (Aviation Noise Impact Management through Novel Approaches) project and for some of the outcomes secondly in June 2019. This literature review gives a stronger evidence basis for the health effects of aircraft noise exposure on the cardiovascular and metabolic system, sleep quality, cognitive functioning, mental health and well-being as well as the extent to which these outcomes are associated with annoyance. Our findings also show that various study limitations are present in the research. The quality of research and consequently its validity could be improved, if limitations in study design, participant selection, exposure assessment, outcome characterization and confounding were considered and addressed in more details.

28065 - Transportation noise and risk for stroke: A nationwide cohort study covering Denmark

3. Non-auditory health effects of noise
Keywords: Road traffic noise, stroke, incidence, nationwide
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Studies on transportation noise and incident stroke are few and inconclusive.

We identified all persons >35 years, alive in 2000 (start of follow-up) and living in at least one Danish dwelling from 1990 (ensured ≥10-y exposure) until 2017. In total, 3.6 million persons were included, of whom 184,523 developed incident stroke during follow-up. Address history from 1990-2017 were identified for all, and road traffic noise (L_{den}) at the most and least exposed façades were modeled. Analyses were done using Cox, with adjustment for various personal and area-level confounders and air pollution.

A 10 dB increase in 10-year mean road traffic noise at the most exposed façade was associated with an incidence rate ratio (IRR) of 1.04 (95% confidence interval (CI): 1.03–1.05) for all strokes. For road traffic noise at the least exposed façade, the IRR per 10 dB was 1.03 (95% CI: 1.02–1.04) for all strokes. Railway noise was not associated with a higher risk for strokes.

In conclusion, road traffic noise increased risk for incident stroke, adding to the evidence of road traffic noise as a cardiovascular risk factor.

28083 - Noise exposure and childhood asthma up to adolescence

3. Non-auditory health effects of noise
Keywords: Road-traffic, maternal occupation, asthma, childhood, adolescence
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Objective: Noise is a psychological/physiological stressor and may aggravate immune-mediated diseases. However, evidence is scarce about its effects on children´s respiratory health. We investigated associations between pre- or postnatal noise exposure and asthma up to adolescence.

Methods: The study was conducted in a Swedish birth cohort including over 4000 participants followed until 16 years of age. Time-weighted average residential road traffic noise levels were estimated at the most exposed façade. Maternal occupational noise exposure during pregnancy was evaluated using a job-exposure-matrix. Associations between noise exposure and asthma were explored using logistic regression and generalized estimating equations.

Results: Non-significant associations were observed for asthma ever up to 16 years with road traffic noise exposure in infancy ≥55 dB_{Lden} (OR=1.22; 95% CI 0.90-1.65), as well as maternal occupational noise exposure during pregnancy ≥80 $dB_{LAeq,8h}$ (OR=1.18, 0.85-1.62). No clear or consistent associations between pre- or postnatal exposure to road traffic noise were detected in relation to asthma in longitudinal analyses.

Conclusion: We did not find clear overall associations between exposure to noise during different time periods pre-or postnatally and asthma up to adolescence.

28310 - Triggering effects of aircraft noise on mortality: a case-crossover study

3. Non-auditory health effects of noise

Keywords: case-crossover, triggering, aircraft noise, cardiovascular mortality

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There is increasing evidence of the health consequences of chronic exposure to traffic noise. However, little is known about the acute effects of noise on mortality. In this study, we investigate the triggering effect of nighttime aircraft noise exposure on cardiovascular mortality in Switzerland. Flight patterns and directions vary from day to day at Zurich airport (ZRH), offering sufficient exposure variability to conduct a case-crossover study. We used mortality data from the Swiss National Cohort and assessed individual noise exposure at participant's home address using flight lists from ZRH and noise models previously developed for major aircraft types, flight routes and schedules. We found 7,641 cardiovascular deaths occurring during the night (23:00-07:00) between the years 2000 to 2015 and conducted conditional logistic regression, adjusting for estimated temporal and spatial NO2 exposure, temperature and precipitation. For the nighttime 2-hour exposure window prior to the event, preliminary analyses suggest that aircraft noise is a trigger for cardiovascular deaths. Further analyses will be performed and presented, including the investigation of noise exposure in additional nighttime windows and for specific cardiovascular causes of death.

28339 - Road traffic noise and incident atrial fibrillation in the Danish Nurse Cohort

3. Non-auditory health effects of noise
Keywords: Road traffic noise, Atrial Fibrillation, Danish Nurse Cohort
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Background: Long-term exposure to transportation noise has been linked to cardiovascular diseases, though evidence pertaining to atrial fibrillation (AF) is sparse.

Methods: Time-varying Cox proportional hazards models were used to investigate the association between exposure to road traffic noise, for up to 23 years, and AF incidence among 23,528 Danish Nurse Cohort participants, adjusting for air pollution. Road traffic noise, estimated using the Nord2000 model, was modeled categorically and continuously. Possible thresholds at 53 and 58 dB, which represent the World Health Organization and the Danish government's respective maximum exposure recommendations, were also explored.

Results: In fully-adjusted models, road traffic noise was significantly associated with AF incidence: compared to a 3-year mean exposure of < 48 dB, hazard ratios (95% confidence intervals) were 1.09 (0.96-1.25) and 1.18 (1.02-1.36), for exposure levels of 48-58, and > 58 dB, respectively. Results were similar for a 1-year mean exposure, and no association was observed for a 23-year mean exposure. Air pollution adjustment increased effect estimates. Suggestions of threshold effects were observed.

Conclusion: Road traffic noise was associated with incident AF in the Danish Nurse Cohort.

28474 - Maternal exposure to residential traffic noise in relation to pregnancy complications - Preliminary results from the NordSOUND study

3. Non-auditory health effects of noise
Keywords: noise, traffic, pregnancy complication, Nordic countries, registers
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Introduction

The NordSOUND project utilises high-quality register data in the Nordic countries to comprehensively study the health effects of environmental and occupational noise. The present study aims at assessing whether residential traffic noise is associated with the risk of pregnancy complications.

Materials and methods

The study areas were metropolitan Copenhagen (2005–2016), Helsinki (2004–2014), Gothenburg and Stockholm (2007–2012), and the total number of pregnancies was around 420,000. Data sources were national population and patient registers. Residential yearly averages for noise and air pollution exposure were modelled. Logistic regression analyses were adjusted for demographic variables, lifestyle factors, area level indicators of socio-economic status, air pollution, and green and blue areas.

Results

No consistent associations were observed in the four study areas between road or rail traffic noise exposure during pregnancy and gestational diabetes, gestational hypertension or severe pre-eclampsia. Further sensitivity analyses will be conducted.

Conclusion

These preliminary results do not support the hypothesis that traffic noise exposure could complicate pregnancy at least in the Nordic countries.

28513 - Aircraft noise exposure and saliva cortisol in the DEBATS longitudinal study

3. Non-auditory health effects of noise
Keywords: epidemiology, aircraft noise exposure, health, cortisol
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Although aircraft noise is known to impact human health, the biological pathway is still unclear with one possible pathway being hormonal disturbance and the modification of the cortisol circadian rhythm.

This longitudinal study aimed to characterize the influence of aircraft noise on cortisol.

1,115 participants living near three French major airports answered in 2013, 2015 and 2017 detailed face-to-face interviews and collected two saliva samples: one after awakening and one before going to sleep. ELISA kits were used to determine cortisol levels in saliva. Outdoor noise levels were estimated at each home address using noise maps. Longitudinal analyses were performed using linear mixed model adjusted on potential confounders.

A 10dB(A) increase in L_{den} levels was associated with decreased relative daily variation of cortisol ($\exp(\beta)=0.79$; 95% confidence interval: 0.71-0.87), higher evening cortisol levels ($\exp(\beta)=1.17$; 95% CI: 1.09-1.25) and unchanged morning levels ($\exp(\beta)=0.96$; 95% CI: 0.91-1.02).

In our longitudinal study, aircraft noise exposure was associated with flattened diurnal cortisol rhythm across the day, indicating a possibly disturbed hypothalamus-pituitary-adrenal axis regulation. These findings confirms those based on the data collected in 2013 only.

28609 - Night-time aircraft noise and cancer - the Cologne-Bonn Airport study

3. Non-auditory health effects of noise
Keywords: Night-time aircraft noise, Cancer
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Cancer of various types has been reported first in the immediate vicinity of Amsterdam-Schiphol airport (Visser et a. 2005) as results of a cohort study. Recently increased breast cancer risks were detected in the vicinity of Cologne-Bonn airport (Greiser et al., 2010) and in the vicinity of Frankfurt airport (Hegewald et al. , 2017) in case-control studies. A systematic analysis of the Cologne-Bonn airport data comprised all persons insured in 8 compulsory sickness funds (N= 1.022.605), excluding 58.841 who were entitled to receive reimbursement for noise protection of bedroom windows. Night-time aircraft noise comprised Leqs from 36-62 dB(A). Multivariate logistic regressions in persons aged 40+ resulted in odds ratios(ORs) for an increase of 10 dB(A) Leq, which in general were larger in women than in men. ORs for men vs. women:

all cancers	1.015(1.012-1.017)	vs. 1.028(1.025-1.032)
lung	1.017(1.011-1.014)	vs. 1.067(1.055-1.080)
kidney	1.002(.0989-1.003)	vs. 1.033(1.011-1.055)
colon	1.001(1.000-1.015)	vs. 1.039(1.029-1.048)
NHL	1.002(.099-1.015)	vs. 1.032(1.014-1.05)
M Hodgkin	1.042(1.005-1.081)	vs. 1.221(1.155-1.292)
uterus		1.074(1.058-1.090)
cervix		1.031(1.011-1.052)
breast		1.022(1.017-1.028)

These results could be due to the impact of gases and microfine particles from traffic exhausts.

28629 - Long-term exposure to road traffic noise and myocardial infarction in women: the Danish Nurse Cohort

3. Non-auditory health effects of noise
Keywords: cohort studies, incidence, myocardial infarction, noise, proportional Hazards Models
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Objectives: Evidence of the non-auditory effects of road traffic noise exposure on public health is growing. We investigated the adverse health effects of long-term exposure to road traffic noise on myocardial infarction (MI) incidence.

Methods: We used the Danish Nurse Cohort with 23,640 female nurses who at recruitment in 1993 or 1999 reported information on risk factors, and obtained MI diagnostic data from the Danish National Patient Register until 2014. We examined the associations between multi-year (up to 23 years) exposures to road traffic noise and MI incidence using time-varying Cox regression models and estimated thresholds using piece-wise linear regression models after controlling for individual covariates and air pollution levels.

Results: We observed a non-linear relationship between MI incidence (N=591) and road traffic noise. Notably, in fully-adjusted models of a 23-year running mean exposure at or above 53, 55, and 58 dB, hazard ratios (95% confidence intervals) were 1.36 (1.05, 1.77), 1.47 (1.08, 1.99), and 1.58 (1.03, 2.40), respectively, per 10 dB.

Conclusion: Results suggest that road traffic noise ≥ 53 dB may significantly increase the risk of MI.

28700 - Health effects of aircraft noise: overview of the cross-sectional DEBATS study's results

3. Non-auditory health effects of noise
Keywords: epidemiology, aircraft noise exposure, health, France
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DEBATS is the first research to focus on the effects of aircraft noise on the health of people living near airports in France. A total of 1,244 residents (Paris-Charles de Gaulle, Lyon-Saint-Exupéry and Toulouse-Blagnac) were included in 2013. Information about their health, socioeconomic and lifestyle factors was collected by means of a face-to-face questionnaire performed at home by an interviewer. Aircraft noise exposure at participants' homes was estimated with noise maps. The cross-sectional results of the DEBATS study at enrolment confirm those of previous ones conducted abroad. Indeed, they suggest that aircraft noise exposure decreases subjective and objective sleep quality, and increases the risk of hypertension and the one of psychological distress. They also suggest an association between this exposure and a smaller variation of cortisol levels over the day. Moreover, they provide further evidence that community aircraft noise annoyance has increased over the past decades. However, all these results have to be confirmed by longitudinal studies. This is in progress in particular with longitudinal analyses of the data collected in 2013, 2015 and 2017 in the present DEBATS study.

28707 - Self-rated health status in relation to aircraft noise: the results of the DEBATS study

3. Non-auditory health effects of noise

Keywords: epidemiology, aircraft noise, annoyance, noise sensitivity, self-rated health status

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Only three studies have considered self-rated health status (SRHS) in relation to aircraft noise, but no study has addressed the role of aircraft noise annoyance or noise sensitivity in this relationship. The present study investigates the association between aircraft noise and SRHS of people living near airports in France, and evaluates the role of aircraft noise annoyance and noise sensitivity in this association. A total of 1,230 residents (Paris-Charles de Gaulle, Lyon-Saint-Exupéry and Toulouse-Blagnac) were included. Information on their SRHS, demographic and lifestyle factors, aircraft noise annoyance, and noise sensitivity was collected during an interview. Aircraft noise exposure at participants' homes was estimated with noise maps. Aircraft noise levels were found to be positively associated with a weakened SRHS, only in men. This association was higher in men highly sensitive to noise compared to those not highly sensitive to noise, suggesting that noise sensitivity would moderate this association. It was slightly lower when annoyance was included in the model, suggesting a mediating effect of annoyance. However, these last two results need to be confirmed using more advanced statistical models.

28752 - The relationship between everyday sounds and human cardiovascular regulation: evidence from real-world data

3. Non-auditory health effects of noise
Keywords: Real-world, everyday sounds, cardiovascular system, datalogging
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Although widely accepted, there are little data illustrating how everyday sounds impact the human cardiovascular system (Flamme et al., 2012). Here, using data from Oticon A/S internet-connected hearing aids, we investigated the longitudinal association between acoustic data logged from hearing aid microphones and continuous mean heart rate measures logged by the user's (N = 54) own wearable over a 3-month period. The acoustic data characterizes the momentary sound pressure levels (SPLs) of everyday sounds (from 20 to 95 dB), and signal-to-noise ratios (SNRs) as aggregate measures from 5-minutes preceding each heart rate measure. We find that a 12 dB increase in ambient SPL is significantly related to a 4.5% increase in heart rate, corroborating prior laboratory (Shoushtarian et al., 2019) and real-world data (El Aarbaoui & Chaix, 2019). In addition, we find that a 7 dB increase in the ambient SNR is associated with a 3.5% decrease in heart rate. Our findings suggest a mixed influence of everyday sounds on cardiovascular stress, and that the relationship is more complex than is seen from examination of sound intensity alone.

28764 - Hypertension incidence in relation to aircraft noise: Results of the DEBATS longitudinal study in France

3. Non-auditory health effects of noise
Keywords: epidemiology, aircraft noise, hypertension, France
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Although aircraft noise exposure was found to be associated with higher risk of hypertension in cross-sectional studies, a limited number of longitudinal studies have addressed this issue.

This study aimed to investigate the association between this exposure and the incidence of hypertension.

This prospective study included in 2013 1,244 adults living near three French airports. Systolic and diastolic blood pressure, and demographic and lifestyle risk factors were collected at baseline and after two and four years during face-to-face interviews. Aircraft noise exposure was estimated for each participant's home address using noise maps. Analysis was performed using mixed Poisson and linear regression models adjusted on potential confounders.

A 10dB(A)-increase in aircraft noise levels was associated with higher hypertension incidence (IRR (incidence rate ratio)=1.34 (95%CI=1.00-1.78) for L_{den}). The association for L_{night} was at the borderline of statistical significance (IRR=1.29 (95%CI=0.99-1.68)). Systolic and diastolic blood pressure also increased with all noise indicators.

These results strengthen those obtained from cross-sectional analysis of the data collected at inclusion and support the hypothesis that aircraft noise exposure may be considered as a risk factor of hypertension.

28872 - Construction noise and health – a case for further research?

3. Non-auditory health effects of noise
Keywords: construction, annoyance, health, research,
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There is very little evidence in the published literature relating noise from construction sites to health in contrast to that for transportation noise (Basner at al, 2014). Partly, this is because noise exposure from construction is inconsistent over time (Lee et al, 2015) and is difficult to measure meaningfully using energy averaged measures. Also construction noise exposure is often relatively transient making it difficult to capture health effects. Finally, construction noise is often confounded by road traffic noise exposure.

A narrative review of the existing literature was carried out. The few existing studies suggest that construction noise is annoying and is related to disturbances in communication, concentration and sleep. Multiple sources of noise seem to be more annoying than single sources. In terms of health effects there is little that can be concluded. These studies do not reveal any thresholds for the onset of high annoyance. There is a good case for further research to establish a firmer foundation for recommended noise levels from construction sites and to determine whether construction noise exposure is associated with effects on health.

28907 - Cardiovascular mortality and transportation noise in Switzerland, a 15-year analysis

3. Non-auditory health effects of noise
Keywords: CVD, myocardial infarction, mortality, cohort
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Transportation noise from road, rail and air traffic can be detrimental to health and wellbeing. Previous studies, including our own, have shown death from specific cardiovascular diseases (CVD) to be associated with these exposures. Now, with 15 years of follow-up, integrated address history and noise exposure data for multiple years corresponding to census decades, we conducted an extended analysis of the Swiss National Cohort. Mean exposure in 5-year periods were calculated, and three virtual sub-cohorts were defined (2001-2006, etc.) in addition to the full cohort (2001-2015). Multi-pollutant (Lden_road, Lden_rail, Lden_air), time dependent Cox proportional hazards models were applied to 4.14 million adults and adjusted for potential confounders and $PM_{2.5}$. During the 15-year follow-up, there were 277,506 CVD and 34,200 myocardial infarction (MI) deaths. In the full cohort, there was an increased risk of death for road traffic (1.029 [1.024−1.034] CVD; 1.043 [1.029−1.058] MI per 10dB), railway (1.013 [1.010−1.017] CVD; 1.020 [1.010−1.030] MI) and aircraft noise (1.040 [1.020−1.060] MI). Hazard ratios were remarkably consistent with our previous analysis with follow-up until 2008, and were relatively similar across the three virtual sub-cohorts.

28918 - Noise effects on health in studies in Low-Middle-income-countries (LMICs): a narrative review update of epidemiological evidence

3. Non-auditory health effects of noise
Keywords: non-auditory health, review, annoyance, sleep disturbance, cardiovascular disease,
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Noise has been found to be linked to adverse non-auditory health problems, including annoyance, sleep disturbance, hypertension and impaired cognitive function. However, most review studies on these topics focus on studies in developed countries; . This review focussed on studies in Low-and Middle-income-countries (LMICs). We conducted a literature search of Medline supplemented with specialist journal hand search and identified relevant 35 studies.

Twenty-nine of the 35 studies in LMICs assessed exposure based on monitoring, three with subjective ratings and two with traffic counts, only one used modelling. Sixteen of the 35 studies looked at annoyance; as with non-LMIC studies higher noise levels were found to lead to higher annoyance in LMICs. Fifteen of 35 studies examined cardiovascular outcomes (mainly blood pressure or hypertension) of which 13 found adverse associations with noise exposure. Two studies considered cognitive impairment but findings were inconclusive. A meta-analysis was not possible due to variability of the study designs. This review will helpinform further studies and health-based recommendations in LMICs generally considered to suffer from heavier noise pollution.

28948 - Traffic noise exposure and dementia incidence in older adults: a nationwide cohort study

3. Non-auditory health effects of noise
Keywords: Traffic noise, noise exposure, dementia, cognition,
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Dementia represents a major burden for the health and social care systems, affecting millions of individuals worldwide. In this study, we aimed to investigate the association between traffic noise and incident dementia, for all persons > 60 years living in Denmark. Road traffic and railway noise have been modeled for all Danish residential addresses for the period 1990-2018. We started follow-up in 2004, enabling us to investigate effects of up to 15-years of noise exposure. All incident cases of dementia and dementia subtypes (i.e. Alzheimer's disease, vascular dementia, frontotemporal dementia, and Parkinson's disease dementia) were identified by hospital and prescription registries. Analyses were based on Cox Proportional Hazard models, with adjustment for potential individual and area-level confounders, and air pollution. Transportation noise was associated with a higher risk for different dementia outcomes, e.g. ten-year mean residential exposure to road traffic noise (per 10 dB) at the most and least exposed façades were associated with all-cause dementia, with incidence risk ratios of 1.05 (1.04-1.06) and 1.09 (1.08-1.10), respectively. The study suggests noise may play a significant role in increasing risk for dementia.

29015 - Does envirenmental noise exposure influence the occurrence of hypertensive disorders of pregnancy? A case control study conducted in two moderately exposed cities in France.

3. Non-auditory health effects of noise

Keywords: Hypertensive disorders of pregnancy, , environmental noise exposure, gestational hypertension

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The objective was to analyze the relationship between exposure to noise in moderately polluted cities and hypertensive disorders of pregnancy (HDP). A case-control study was conducted in 418 case of HDP and 1671 control pregnant women in the maternity units of two university hospitals. HDP was retained when gestational hypertension, preeclampsia or eclampsia was identified in medical records. The daily equivalent A-weighted noise level ($L_{Aeq,24h}$) was assessed by modeling environmental noise at the home of residence. Sensitivity analyses were conducted using different noise indicators and in different subgroups: with maternal age of cases ≥ 30 versus < 30 years old, without history of chronic hypertension, with versus without preeclampsia or eclampsia. The crude and adjusted OR associated with HDP for an increase of 5 dB of $L_{Aeq,24h}$ were 1.00 (95%CI = 0.91; 1.11) and 0.97 (95%CI = 0.87; 1.09), respectively. The results were similar in the sub-group analyses or when considering $L_{Aeq,day}$, $L_{Aeq,evening}$, $L_{Aeq,night}$, L_{den}. Our results are in favor of an absence of effect of noise on the occurrence of hypertensive disorders of pregnancy for moderate levels of environmental noise.

29017 - Non-auditory health effects of noise: an overview of the state of the science of the 2017-2020 period.

3. Non-auditory health effects of noise
Keywords: health, review, cardio-metabolic, mental health, birth outcomes
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This paper provides an overview of non-auditory health effects of noise published since the last ICBEN conference in 2017. The paper takes as a point of departure current reviews and adds new research from literature searches from peer reviewed journal articles in the large databases, of the impact of environmental and occupational noise on cardiovascular and metabolic effects, mental health, birth outcomes, and less common outcomes such as cancer. The aim is to describe recent research achievements, emerging areas of research, remaining gaps of knowledge, and priority areas of future research in the field of non-auditory health effects of noise.

29019 - Residential exposure to traffic noise during pregnancy and birth outcomes – preliminary results from the NordSOUND study

3. Non-auditory health effects of noise
Keywords: residential noise, pregnancy, birth, growth restriction, NordSOUND
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Background: Studies have indicated that occupational exposure to noise during pregnancy may increase the risk of adverse birth outcomes, but it is unclear whether there is an increased risk at exposure levels common in residential areas.

Objectives: To assess whether residential noise exposure during pregnancy is associated with the risk of small-for-gestational age, preterm birth, and low birth weight.

Methods: Registry-based cohorts from Sweden (n=179,194), Denmark (n=114,031) and Finland (n=124,792) were used, and residential noise exposure from road traffic was modelled. Country-specific results of logistic regression analyses adjusted for potential confounders (maternal age, parity, marital status, smoking and education [not in Finland]) were combined in meta-analyses.

Results: Preliminary results indicate that residential exposure to noise at high levels was associated with an increased risk of small-for-gestational age (Sweden and Denmark). However, there were no increased risks for preterm birth or low birth weight (all countries).

Conclusions: Traffic noise may be associated with an increased risk of small-for-gestational age, but the analyses will be repeated with a more extensive set of confounders, including air pollution and proportion of green/blue neighborhood areas.

29023 - Combined effects of noise and air pollution

3. Non-auditory health effects of noise
Keywords: air-noise interaction; cardiovascular effects; hypertension; diabetes
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Air pollution exposure may be a confounder in epidemiological studies on health effects due to noise pollution, and vice versa. This paper summarizes recent existing evidence for myocardial infarction due to transportation noise and air pollution exposures; the risk of incident heart failure due to long-term exposure to road traffic noise and nitrogen dioxide; the risk of incident hypertension due to road traffic noise and air pollution exposure; the link between long-term exposure to transportation noise and air pollution exposure and incident diabetes; and the possible relation between exposure to noise and air pollution and dementia. Essential concludions are: Transportation is associated with myocardial infarction independent of air pollution, but air pollution studies not adjusting for noise exposure may overestimate cardiovascular disease burden of air pollution. High exposure to road traffic noise and nitrogen dioxide was associated with the highest risk of incident heart failure, mainly among men No clear association appears to exist between incident hypertension, air pollution and road noise. Road and aircraft noise seem to be more relevant than railways noise and nitrogen dioxide in diabetes development.

29031 - Maternal exposure to occupational noise in relation to congenital malformations - preliminary results from the NordSOUND study.

3. Non-auditory health effects of noise
Keywords: pregnancy, birth outcomes, abnormalities, occupational noise, mother
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Background
The research project NordSOUND makes use of high-quality health register data to comprehensively study health impacts due to environmental and occupational noise. The linkage of several countries data is crucial for rare outcomes.
This presentation evaluates whether occupational noise during the mothers' pregnancy is associated with the risk of congenital malformations. The full analyses include Copenhagen, Helsinki, Gothenburg, Stockholm and Oslo. Here we present results from the Copenhagen cohort (2005-2016).

Methods
The sample includes 114,693 live single births. Data sources were national registers. We assessed the mothers' occupational exposures using a validated noise job- exposure matrix. Residential noise pollution were modelled. Logistic regression analyses adjusted for maternal age, parity, mothers' medication, marital status, smoking, individual and area-level socioeconomic status, and road, rail and air traffic noise.

Results
No associations were observed between occupational noise during pregnancy and congenital malformations. Future analyses will include all Nordic countries, and more extensive analyses of confounders related to work participation.

Conclusion
These preliminary results do not support the hypothesis that exposure to occupational noise during pregnancy is associated with congenital malformations

29032 - Living close to the railway: effects of vibration from rail traffic on diabetes prevalence.

3. Non-auditory health effects of noise
Keywords: rail traffic vibration, diabetes
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Rail traffic is expected to increase in Sweden following policy recommendations for a more sustainable transportation model. Still, little is known about the health effects of rail traffic vibration for people living close to the railways. This study aim to investigate the effects of rail traffic vibration on diabetes and to assess how rail traffic noise affects this association. The study population (N=5381) was randomly selected from residents living within 1km of a trafficked railway in Västra Götaland, Sweden. Survey data was combined with modeled exposures and health register data (ICD10 codes). The study uses a cross sectional design and logistic regression analysis. Preliminary results suggest an increase in the prevalence of diabetes (OR=1.06; 95% CI 1.01-1.12) associated with the exposure to vibration, accounting for sociodemographic and life style factors. Rail traffic noise seems to be a modifier in the association. Analysis of an interaction between vibration and noise is ongoing. Findings have implications for the researcher community and also decision-makers in the areas of public health, infrastructure, housing and transportation planning.

33675 - Long term exposure to transportation noise and risk for type 2 diabetes in a nationwide cohort study from Denmark

3. Non-auditory health effects of noise
Keywords: diabetes mellitus, type 2 diabetes, Epidemiology, cohort
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Objective: To examine the influence of long-term residential exposure to transportation noise at the loudest and quietest residential façades and risk for type 2 diabetes (T2D).

Methods: Road traffic and railway noise (L_{den}) at the most and least exposed façades were estimated for all residential addresses across Denmark over the period 1990-2017. Ten-year time-weighted mean noise exposure for 3.56 million individuals were estimated. Of these, 233,912 incident cases of T2D were identified using Danish registries. Analyses were conducted using Cox proportional hazards models with adjustment for individual and area-level sociodemographic covariates and air pollution.

Results: A 10 dB increase in 10-year-mean road traffic noise exposure at the most and least exposed façades were associated with IRRs and 95% CI for T2D of 1.05 (1.04-1.05) and 1.09 (1.08-1.10), respectively. For railway noise, the IRRs per 10 dB increase in 10-year mean exposure were 1.03 (1.02-1.04) and 1.02 (1.01-1.04) for the most and least exposed façades, respectively.

Conclusions: We found that long-term exposure to road, railway and potentially aircraft noise was associated with higher risk of T2D.

33885 - Long-term aircraft noise exposure and incident hypertension in national US cohort studies

3. Non-auditory health effects of noise
Keywords: aircraft, noise, health, hypertension
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Few cohort studies have examined relationships between aircraft noise and health, none in the US. We evaluated associations between aircraft noise and incident hypertension in three national cohorts of women, the Nurses' Health Studies (NHS/NHSII) and the Women's Health Initiative (WHI). Noise levels around 90 airports for 1995-2015 (in 5-year intervals) were modeled using the Aviation Environmental Design Tool and assigned to participants' geocoded addresses over time. Hypertension risks were estimated using time-varying Cox proportional-hazards models for day-night average sound level dichotomized at 45 and 55 decibels (dB), adjusting for fixed and time-varying covariates.

Cases were 31,421, 29,086, 26,718 over 0.7M,1.3M, and 0.8M person-years in NHS, NHSII, and WHI, respectively. In combined NHS/NHSII, we observed adjusted hazard ratios (HRs) of 1.03 (95% CI: 0.99, 1.07) for 45 dB and 1.06 (95% CI: 0.98, 1.15) for 55 dB cut-points. In contrast, in WHI, we observed preliminary HRs of 0.98 (95% CI: 0.96, 1.01) for 45 dB and 0.99 (95% CI: 0.93, 1.05) for 55 dB cut-points. Further research is needed to identify reasons for differences between cohorts and characterize vulnerable populations.

33953 - Long-term exposure to transportation noise and risk of incident stroke: A pooled study of nine Scandinavian cohorts

3. Non-auditory health effects of noise
Keywords: Road traffic noise, railway noise, stroke
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Transportation noise is increasingly acknowledged as a cardiovascular risk factor, but the evidence-base for an association with stroke is sparse.

We harmonized and pooled data from nine Scandinavian cohorts, totalling 135,951 participants. We identified address history and estimated road, railway and aircraft noise. We analysed data using Cox Proportional Hazards Models, including socioeconomic and lifestyle confounders, and air pollution. During follow-up, 11,056 stroke cases were identified in national registries.

We found road traffic noise (L_{den}) to be associated with risk of stroke, with an incidence rate ratio of 1.05 (95% confidence interval: 1.03-1.08) per 10 dB higher 5-year mean time-weighted exposure. This association followed a close-to-linear exposure-response relationship and persisted also after adjustment for air pollution ($PM_{2.5}$ and NO_2). Intermediate exposure to aircraft noise (40-50 dB) seemed associated with a higher risk of stroke, whereas no association was observed among highly exposed (≥50 dB). Railway noise was not associated with stroke.

In conclusion, road traffic noise was associated with higher risk of stroke. This finding adds to the evidence of road traffic noise as an important cardiovascular risk factor.

33966 - Long-term exposure to road traffic noise and incidence of COPD: the Danish Nurse Cohort

3. Non-auditory health effects of noise
Keywords: Road traffic noise; COPD incidence; adults; the Danish Nurse Cohort
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Background: Evidence on the role of environmental noise in the development of chronic respiratory diseases is just emerging. We examined association between long-term exposure to road traffic noise and incidence of chronic obstructive pulmonary disease (COPD).

Methods: Time-varying Cox regression models were performed to examine the associations of long-term exposure to road traffic noise (L_{den}) with COPD incidence in the Danish Nurse Cohort, which included 28,731 female nurses > 44 years. Residential annual mean concentrations of L_{den} were estimated using the Nord2000 model. We examined the robustness of associations by adjusting for air pollutants: particulate matter with diameter < 2.5 μm ($PM_{2.5}$) and nitrogen dioxide (NO_2).

Results: 977 nurses developed COPD during 18.6 years' mean follow-up. Three-year running mean of L_{den} was associated with COPD with a hazard ratio (HR) of 1.15 (95%CI: 1.06-1.25) per 10 dB increase, which was robust to adjustment for NO_2 (1.08; 0.98-1.21) and $PM_{2.5}$ (1.13; 1.03-1.24). No interaction effects were observed between noise and air pollutants.

Conclusions: Long-term exposure to road traffic noise was associated with COPD, independently of air pollution.

33973 - Long-term exposure to road traffic noise and all-cause and cause-specific mortality: a Danish Nurse Cohort Study

3. Non-auditory health effects of noise
Keywords: Road traffic noise, mortality, Danish Nurse Cohort, Air pollution
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Background: Road traffic noise was linked to cardiovascular disease (CVD) and diabetes morbidity, while evidence on mortality is limited.

Methods. We linked 23,112 female nurses from the Danish Nurse Cohort, recruited in 1993 or 1999, to the Danish Register of Causes of Death until the end of 2013. Road traffic noise levels since 1970 were estimated as the annual mean of a weighted 24h average (L_{den}). We used Cox regression to link L_{den} to mortality, adjusting for confounders and air pollution.

Results. During a mean 17.3 years of follow-up, 3,326 nurses died. Comparing 5-year mean L_{den} levels of 48-58dB and > 58dB to <48 dB (Reference), the adjusted hazard ratios (95% confidence intervals) were: 1.14 (1.03-1.27) and 1.16 (1.03-1.31) for all-cause, 1.21 (0.97-1.52) and 1.27 (0.98-1.64) for CVD, 2.00 (1.25-3.20) and 1.91 (1.13–3.23) for stroke, 1.08 (0.50-2.34) and 1.38 (0.59-3.23) for diabetes, 1.52 (0.89-2.62) and 1.25 (0.68-2.30) for dementia, 1.14 (0.77-1.70) and 1.17 (0.75-1.82) for respiratory, 1.03 (0.88-1.19) and 1.07 (0.90-1.28) for cancer mortality.

Conclusion: Long-term exposure to road traffic noise may increase the risk of mortality, independent of air pollution.

34010 - Relationship between road traffic noise and adverse birth outcomes: Analysis of the birth cohort of the Hokkaido Study

3. Non-auditory health effects of noise
Keywords: road traffic noise, epidemiological study, low birth-weight, preterm birth
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Sleep disturbance of pregnant women due to environmental noise may affect fetal growth: it may lead to adverse birth outcomes such as low birth-weight, preterm birth, and term-small-for-gestational-age. However, the exposure-response relationships between noise exposure and the risks remain unclear. The objective of the present study is to investigate the relationship between road traffic noise and adverse birth outcomes. We analysed the birth cohort of the Hokkaido Study of Environment and Children's Health, which is the first large-scale prospective birth cohort study in Japan. We employed multivariate logistic regression analysis to investigate the effect of road traffic noise exposure during night-time, adjusting with confounders such as physiological differences (sex, age, parity, etc.) and lifestyles (smoking and drinking habit, occupation, etc.).

34023 - Residential road traffic noise exposure and emotional, aggressive, and attention deficit and hyperactivity disorder symptoms in children from two European birth cohorts

3. Non-auditory health effects of noise

Keywords: noise pollution, transportation noise, anxiety, behavioral symptoms, longitudinal studies

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We aimed to examine the association between prenatal and childhood road traffic noise exposure (L_{DEN}) and emotional, aggressive, and attention deficit and hyperactivity disorder (ADHD) symptoms in children. We included 536 children from the Spanish INMA Project and 7464 from the Dutch Generation R Study. Average 24h L_{DEN} during pregnancy and childhood was estimated using EU noise maps. Behavioral symptoms were assessed using validated questionnaires at multiple time points during childhood. Adjusted linear mixed models were run separately by cohort and combined with random-effects meta-analysis. Average prenatal L_{DEN} levels were 61.3 (SD 6.1) and 54.5 (8.0), childhood levels were 61.7 (5.8) and 51.5 (7.1) in INMA and Generation R, respectively. Prenatal L_{DEN} was not related to any symptoms. Higher childhood L_{DEN} was associated with lower emotional, aggressive and ADHD symptoms (-0.03 [95%CI -0.05; -0.02], -0.01 [-0.02; -0.00], -0.01 [-0.02; -0.00] per 5dB noise increase). No heterogeneity was observed between cohorts. Our results differ from previous literature that found associations between childhood L_{DEN} and higher ADHD symptoms, though no associations with emotional or aggressive symptoms. Studies including noise sensitivity are warranted.

34032 - Sex/gender differences in the association of environmental noise exposure and cardiovascular health – a systematic review

3. Non-auditory health effects of noise
Keywords: environmental noise, sex/gender, ischemic heart disease, hypertension, systematic review
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Epidemiological studies have demonstrated cardiovascular health effects of environmental noise with partly differing results for males and females. Health outcomes depend on the biological sex but are also determined by gender including social, economic and cultural facets. This review evaluated the current state of how sex/gender is integrated in studies on noise from various sources associated with ischemic heart disease, hypertension and blood pressure. A systematic literature search was conducted using the databases PubMed, Web of Science and Scopus identifying thirty studies published between Jan2000 and Feb2020. Studies did not show consistent results towards males or females and effects were rarely shown to be modified by sex/gender. All studies used a binary operationalization of sex/gender assuming static differences between men and women. No study referred to current sex/gender-theoretical concepts and some used "sex" and "gender" interchangeably. However, biological and social dimensions of sex/gender were unconsciously taken up in the discussion. Integrating sex/gender-theoretical concepts into future studies offers great potential to increase the validity of research findings and thus make them more useful for prevention efforts, health promotion, and health care.

On behalf of the INGER study group

4. Effects of noise on cognition, performance and behaviour

27477 - Influences of noise on autonomic function in infants: understanding early common pathways to atypical emotion regulation and cognitive performance

4. Effects of noise on cognition, performance and behaviour
Keywords: Infant, sustained attention, emotion reactivity, noise, household chaos
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Background: Previous research has suggested that children exposed to noisier early home environments show worse mental health outcomes and impaired cognitive performance in later life, but the mechanisms subserving these relationships remain poorly understood.

Method: Using miniaturised microphones and physiological arousal monitors (Electro-Cardiography, Heart Rate Variability, Actigraphy), we examined time infants' autonomic reactions to environmental noise in the home environment. The same infants also attended a lab testing battery where reactivity to attention- and emotion-eliciting stimuli was assessed.

Results: Children exposed to higher and more rapidly-fluctuating environmental noise showed more unstable autonomic arousal patterns in home settings. In the lab battery, this group showed more labile and short-lived autonomic changes in response to novel attention-eliciting stimuli, along with reduced visual sustained attention. They also showed increased arousal lability in response to an emotional stressor.

Conclusions: Our results offer new insights into the mechanisms by which environmental noise exposure may confer increased risk of adverse mental health and impaired cognitive performance during later life.

28000 - Perceptions of noise at work and road traffic accidents

4. Effects of noise on cognition, performance and behaviour
Keywords: noise at work; road traffic accidents
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There is an extensive literature linking noise at work to accidents in the workplace. The present study extended this research by examining associations between perceptions of exposure to noise levels that led to distraction and road traffic accidents. The survey was completed by 7750 workers from the South Wales region. Perceptions of noise at work were measured using a 5-point rating scale. Road traffic accidents (RTAs) where the person was the driver were recorded and categorised into those at work, commuting to and from work, and in leisure time outside of work. Results showed that those who reported greater exposure to noise at work had more RTAs. This effect remained significant when other predictors of RTAs were statistically controlled for. Perception of noise at work was associated with increased accidents in leisure time but not at work or while commuting. This result confirms findings on after-effects of noise exposure. Further research using a longitudinal design will provide a better indication of causality. Similarly, it is desirable to obtain more information about noise exposure and possible confounding facto

28062 - Review of research on the effects of noise on cognitive performance 2017-2020

4. Effects of noise on cognition, performance and behaviour
Keywords: Cognition, performance, behavior, noise, review
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Corresponding to the topics of Team 4 of the International Commission on Biological Effects of Noise (ICBEN), a literature review is presented covering the years 2017 to 2020 with a focus on the effects of noise on cognition, performance and human behaviour. Sound or noise and cognitive performance, human behaviour as well as several synonymous or related terms will be used in the search string. The overall resulting works will be reduced by keeping only those publications that are topic-related. After a practical screen of the abstracts, the remaining relevant publications will be further analysed. We will present the results of the literature review and discuss the main trends in terms of topics and methodologies.

28318 - The rate of the occupational noise-induced mental workload at medium levels

4. Effects of noise on cognition, performance and behaviour
Keywords: Mental workload, Medium levels, Dose–response relationship, Occupational noise
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Abstract

Occupational noise exposure is associated with several psychological adverse effects and impairs recuperation. The aim of this study was to investigate the effects of the five noise conditions: quiet condition (QC), closed offices (CO), open plan office (OPO), control rooms (CR), and industrial noise (IN)) on mental workload. The noise levels were fixed at 54±0.3 dB(A) (QC), 64±0.4 dB(A) (CO), 68±0.8 dB(A) (OPO), 73±0.3 dB(A) (CR) and 80±0.1 dB(A) (IN). A total of 31 normal hearing male subjects were recruited. They were asked to judge the noise annoyance (NA) and noise-induced mental workload (NIMWL) using NASA-TLX software at the end of each condition. The results were evaluated in the view of the impact of noise and moderating factors using linear models and a dose-response relationship was found for each response. The overall average of the NA rating was 9%, 28.9%, 34.3%, 35.7%, and 40.4%, and also the NIMWL rating was 31.7%, 39.5%, 50.3%, 56.9%, and 64.4% in the QC, CO, OPO, CR, and IN, respectively. The medium levels of occupational noise, besides annoyance, can significantly affect the MWL.

28589 - Beyond change-of-state in auditory distraction: How token set size effects vary with age

4. Effects of noise on cognition, performance and behaviour
Keywords: Auditory distraction; token set size; children; serial recall
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Acoustical environments affect cognitive work. Disruption of serial recall performance by background speech depends upon the content of the to-be-ignored sequence of sound beyond the fact of change. Increments in token set size, the number of different types of sound in such sequences, can increase the extent of disruption: Increments in set size from one (AAAA..) to two (ABABAB…) produce an increased disruption. The subtler increases in disruption with increments in set size beyond two have proved relatively equivocal in adult populations, albeit attaining significance in more sensitive or higher-powered procedures. However, it remained unknown how set size effects vary with age. Here we show in participants aged 8-11 years and 18-38 years, a disruption with set size increments from zero to one, which increases in the adult group, whereas disruptive advantages of two-tokens over one-token and twelve- over two-tokens do not. Modeling moderation and mediation ascertains how, on an individual level, increased age associates strongly with improved performance in quiet and an increased disruption by one token, yet associates weakly with a reduced disruptive advantage of twelve- over two-tokens.

28620 - Better working memory protects against the impact of verbal noise on pupils' mathematics, but not reading comprehension or text recall performance

4. Effects of noise on cognition, performance and behaviour
Keywords: Noise, Classroom, Attention, Working Memory, School Performance
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Classrooms are noisy, yet we know very little about why some children are more impaired by noise than others. We investigated whether the impact of *verbal* (e.g. storytelling) and *mixed noise* (e.g. multi-talker babble with movement) on school performance was modulated by executive function skills.

Sixty-four children (*M* = 10.21 years-old) performed three tasks (text recall, reading comprehension, mathematics) in silence and with 65dB of noise. Thirty-three children were exposed to *verbal noise*, 31 to *mixed noise.* Inhibitory control, and verbal working memory were assessed in silence.

Repeated-measures ANOVAs were run separately for *verbal* and *mixed* noise. There were no main effects of noise. However, the impact of verbal noise on mathematics interacted with WM: children with high WM were less impaired. Inhibitory control was not protective against the impact of noise.

The mechanisms underlying the impact of pupil-generated classroom noise were task-specific. The ability to keep information in mind was important for mathematics performance. Results speak against a general attention mechanism account.

Paper: Massonnié, J., Mareschal, D. & Kirkham, N. (under review). Individual differences in dealing with classroom noise disturbances.

28639 - Subjective assessments of interference by noise during a proofreading task

4. Effects of noise on cognition, performance and behaviour
Keywords: subjective assessments, interference by noise, proofreading
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Effects of noise on humans can be considered in different ways, e.g. by measuring the performance, by recording physiological parameters representing stress reactions, or by asking the persons concerned regarding their experienced disturbance.

In a current research project, we investigate the effects of noise on employees during a proofreading task. In a first study, the participants worked on the task twice in silence (Group 1) or twice in a condition with background speech (Group 2). After working on the reading task, participants were asked to assess the following aspects with respect to the task: (1) experienced effort, (2) concentration, (3) performance and (4) disturbance by the acoustical condition.

Results considering the assessment data will be presented. For example, the analyses did not reveal significant differences between the assessments during the first and the second test run. This result also held for analyses carried out separately for each group. Furthermore, analyses on associations between the assessment data and the performance in the reading task will be shown, in order to determine to what extent particular assessments correspond with performance measures.

28753 - Is speech something special? - The physiological, psychological, and performance influences of speech and wideband steady-state noise

4. Effects of noise on cognition, performance and behaviour
Keywords: Irrelevant speech, Wideband noise, Physiology, Performance, Psychological effects
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Speech is thought to be disturbing and stressful, when performing tasks requiring concentration. Steady-state noise without any special characteristic is thought to be less disturbing. We studied the influence of two sounds: speech and steady-state wideband noise. Both conditions were presented at normal speech level (65 dB LAeq) and spectrum. A between-group laboratory study examined the influence of these conditions on human performance, physiology, and psychological outcomes. Speech condition had 21 participants and wideband condition 19. Psychological (annoyance, workload, and fatigue) and physiological (stress hormones, heart rate variability (HRV) and blood pressure) stress were measured, while participants were performing tasks requiring constant attention (visual and auditive serial recall and N-back). Speech was rated more annoying, loading, and less tiring, but it did not deteriorate performance more than wideband noise did. Speech condition differed in one physiological measure from wideband condition – with time HRV showed more physiological loading. The study suggests that even though speech has a special characteristic that is thought to influence people more than steady-state wideband noise, speech might have only a small additional cost at 65 dB.

28852 - EEG correlates of environmental noise impact in daily life

4. Effects of noise on cognition, performance and behaviour
Keywords: EEG, noise effects, attention, speech, cognitive load
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Although epidemiology has focused on equivalent level indicators to analyze the impact of environmental noise, several scholars blame not considering spectro-temporal fluctuations and meaning for the limited explained variance in exposure-effect relationships. This paper explores a possible pathway. We analyzed EEG data of 24 healthy volunteers exposed to sound of multitalker babble, highway, and fluctuating traffic at 63 dBA. For each, three listening conditions were explored: attending to spoken text (LA), attending to environmental sound (BA), and not attending to any sound (BUA). Based on PCA and predictability of remembering the text, we found that the EEG principal component related to inhibition was strongest for multitalker followed by fluctuating traffic in the BUA condition, while in the LA condition, it was stronger for highway than for fluctuating traffic. The principal component related to cognitive prediction was strongest for highway in the LA condition but strongest for fluctuating traffic in the BUA condition. As these principal components depend on EEG-factors that have been connected to cognitive load, this explains a different impact of different types of environmental sound during daily activities.

28864 - The effect of noise on cognitive development during infancy

4. Effects of noise on cognition, performance and behaviour
Keywords: noise, infancy, attention, sensory processing
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The impact of naturalistic noise on early development is not yet sufficiently understood. Using an eye-tracker, we tested 10- to- 12-month-old infants to see how varying naturalistic auditory noise affects attentional looking patterns. Infants were exposed to either no noise, acute noise (i.e. phone buzzing), or chronic noise (i.e. traffic, muffled TV, etc.) while watching a visual statistical learning paradigm. Furthermore, parents recorded 9 hours of sound levels from their home and completed the Toddler Sensory Profile 2 questionnaire.
Preliminary results reveal that infants in the chronic noise condition demonstrated slower saccadic latencies, and therefore lower attentional control, compared to infants in the no noise and acute noise conditions. When taking into account in-home noise levels, it appears that infants with more experience with noise are better able to selectively pay attention in a highly noisy environment. When considering sensory processing, infants from homes with higher average sound levels ($L(A)_{eq}$) and higher minimum sound levels ($L(A)_{min}$) are trending towards having better auditory processing scores. Thus, environmental noise appears to be influencing the early development of visual attention and auditory processing.

28959 - The interactions between Signal-to-noise ratio and Reverberation time in speech intelligibility and learning

4. Effects of noise on cognition, performance and behaviour
Keywords: Signal-to-noise ratio, Reverberation time, Speech intelligibility, Learning
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Signal-to-noise ratio (SNR) and Reverberation time (RvT) are the main acoustical factors for determining speech intelligibility (SI) and learning in classrooms.
From the theoretical perspective of working memory (WM) and its limited capacity, I will address and review two issues: (1) Are the effects of SNR and RvT of different importance for SI and memory of what was said, and (2) Are the effects of SNR and RvT independent of each other or do they interact in their the effects on SI and memory?
Studies from our own lab have indicated that a low SNR and along RvT more strongly affects learning of a spoken text than the SI.As WM has a limited capacity, it follows that that SNR and RvT they should interact, e.g. when a low intelligibility of the spoken message exhausts the limited WM-resources in the process of identifying what is said.
I will present studies that indicate such an interaction, and also that a long RvT sometimes improves, rather than impairs, memory and learning in certain conditions.

29010 - Differential effects of irrelevant speech and environmental sounds on short-term memory in children and adults

4. Effects of noise on cognition, performance and behaviour
Keywords: Memory, Development, Cognition, Irrelevant Sound Effect
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Short-term memory for visually presented material is impaired by task-irrelevant speech that the participants are instructed to ignore. This so-called Irrelevant Speech Effect (ISE) has been attributed to attentional capture, and to specific interference between preattentive, automatic sound processing and deliberate processes involved in retention of the memory lists.

Aiming to explore the roles of attention control and specific interference in the ISE, we analyzed the effects of background speech and non-speech environmental sounds on short-term memory in third-grade children and adults. If the environmental sounds evoke attentional capture, children should be more affected than adults due to immature attention control.

Irrelevant speech evoked a reliable impairment, which did not differ between age groups. However, only the children were affected by environmental sounds. These findings indicate different mechanisms underlying the effects of background speech and environmental sounds. Theoretical implications and practical consequences for the acoustical design of learning environments are discussed.

29033 - Noise in indoor swimming pools: Insights from a survey and acoustic measurements

4. Effects of noise on cognition, performance and behaviour
Keywords: noise, swimming pool, health effects, room acoustics
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Indoor swimming pools are supposed to be a place to exercise, recreate and enjoy free time. However, many indoor swimming pools show a deficit in appropriate acoustics which can have negative effects on employees and guests. For instance, in previous work surveying sports teachers, acoustics was the ambient condition rated as least satisfying and insufficient speech intelligibility was reported which can be fatal when it comes to security aspects. The presented work contributes to this topic by surveying over 140 employees working in indoor swimming pools and combining these results with room acoustic measurements. Results include the identification of most annoying noise sources, overall satisfaction with ambient conditions and noise-induced health effects among others. Selected results from room acoustic measurements (e. g. sound level, reverberation time) in different indoor swimming pools complement the presentation in order to evaluate the current state of acoustics in indoor swimming pools both subjectively and objectively.

29077 - There's a Bad Noise on the Rise: Looming Sounds Produce Behavioural Attentional Capture

4. Effects of noise on cognition, performance and behaviour
Keywords: .
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Sounds with rising intensity are perceived as looming while falling-intensity sounds are perceived as receding. Looming objects may pose a threat to survival and audition functions as an early warning system to anticipate arrival time and allow time for behavioural avoidance responses. While it is known that individuals make over-anticipation errors for the arrival time of looming objects, to date no study has investigated whether looming and receding sounds differentially capture attention when to-be-ignored. In the current study, looming and receding sounds were simulated in a to-be-ignored telephone ring-tone. In four experiments we demonstrate that looming sounds produce more behavioural attentional capture than receding sounds, as indexed by the disruption they produce to visual-verbal short-term serial recall. However, within those experiments we also establish some boundary conditions for the occurrence of this looming effect. In general, the findings that the acoustical properties of looming sounds are automatically extracted and have the power to attract attention, are consistent with the idea that looming objects constitute a class of stimuli with high biological significance that are prioritized by the attention system.

33145 - Effects of noise, clonidine and idazoxan on eyemovements

4. Effects of noise on cognition, performance and behaviour
Keywords: Noise; central noradrenaline; arousal; eye movements
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The antihypertensive α2-adrenergic receptor agonist, clonidine, has been shown to slow saccadic eye movements. Noise has been shown to reverse clonidine-induced impairment of sustained attention. The present study aimed to test whether the effects of clonidine on saccades and blood pressure were blocked by the selective antagonist, idazoxan, and whether the effect of clonidine was modified by noise. Seventy-six healthy male participants were administered either clonidine 200μg, idazoxan 40mg, the combination of clonidine 200μg plus idazoxan 40mg, or placebo orally, in a double-blind, parallel group design. Half of the subjects, balanced across drug treatment groups, were also administered 80dB white noise via headphones. At baseline and on three occasions after drug administration subjects performed a visually-guided saccade task. Cardiovascular parameters were also measured on each occasion. Clonidine significantly decreased saccade peak velocity compared with placebo. Idazoxan did not show an intrinsic effect on saccades, but fully antagonised the effects of clonidine. Noise had little effect on the speed of eye movements suggesting that the activation of other neurotransmitter systems may underlie the effects of noise on sustained attention.

33673 - Listening effort in adults with different amounts of noise exposure

4. Effects of noise on cognition, performance and behaviour
Keywords: Noise exposure, cognition, dual-task, listening effort
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Objectives

This study aimed to evaluate the effect of the amount of noise exposure on the hearing status and listening effort.

Method

The study included 152 adults (18 and 40 years). Participants completed a self-administered questionnaire regarding the amount of noise exposure. Hearing status was evaluated using pure-tone audiometry and transient evoked OAEs (TEOAEs) as well as distortion product OAEs (DPOAEs). Listening effort was evaluated using a dual-task paradigm (Degeest et al, 2015). Based on the quartiles of their subjective estimation of noise exposure, participants were categorized into a group with low, moderate and high noise exposure.

Results

No difference in hearing thresholds was found between the groups, whereas more absent TEOAEs and DPOAEs were found in the high noise exposed group. Subjects with high noise exposure expend significantly more listening effort compared to the other groups.

Conclusion

The most plausible hypothesis for the results that were found pertains to an effect of noise on the peripheral and central auditory system, or a combination of effects on both the auditory system and the high-level cognitive functions necessary for speech understanding.

33895 - Active noise-cancelling headphones in offices

4. Effects of noise on cognition, performance and behaviour
Keywords: headphones, office noise, performance, stress response, irrelevant speech
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Active noise-cancelling (ANC) headphones are increasingly used in open-plan office workplaces as an individual noise control device. They are used to reduce the disturbance of office noise. Many models also involve a microphone, which enables better communication during phone calls and telemeetings. However, the influence on different settings of ANC headphones on a working person has not been examined considering all aspects including experience, performance, and physiological stress. This study will examine how headphones influence a working person during task irrelevant speech in five different conditions. The experiment will measure subjective experience, performance, and physiological stress response. Tasks will be working memory tasks requiring constant concentration (serial recall and n-back). Physiological stress response will be examined by heart rate variability. The experiment will have 50 participants and conducting the experiments has now started. The experiment will be finished before the conference paper is due and we would like to present the preliminary results in the conference.

33947 - Road traffic noise and behavioural outcomes: a prospective cohort study in Swiss adolescents

4. Effects of noise on cognition, performance and behaviour
Keywords: transportation noise, adolescent health, behaviour
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Studies have shown that noise exposure is related to various behavioural disorders in children, in particular hyperactivity and inattention. We studied behavioural change within one year in 882 adolescents ($mean_{age}$ = 10-17) in response to road traffic noise exposure.

Participants filled in a comprehensive questionnaire twice. It included the Strengths and Difficulties Questionnaire (SDQ). We modelled road traffic noise for participants' most exposed façade at home addresses, as well as additional environmental exposures. We addressed missing data with multiple imputation and performed mixed linear cross-sectional analyses and longitudinal change score analyses. In cross-sectional analyses, peer relationship problems increased by 0.14 (95%CI = 0.01-0.27) units per 10 dB road traffic noise increase. No associations were observed in the longitudinal analyses. Further, for adolescents whose bedroom faced the busiest street by their house, we found higher hyperactivity in cross-sectional (0.24, 95%CI = 0.04, 0.44) and longitudinal analyses (0.35, 95%CI = 0.07, 0.64).

This study suggests that orientation of the bedroom needs to be taken into account when investigating effects of traffic noise on behaviour.

33980 - A concept to evaluate activity-based acoustic settings in primary schools appropriate for children's hearing

4. Effects of noise on cognition, performance and behaviour
Keywords: activity-based acoustic settings, primary schools, children
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Objective description of noise perception in educational buildings is a complex topic. In this process, it is desirable to incorporate temporal and spectral features of the noise environment while taking the human characteristics of sound perception in the situation into account. The goal is to establish a realistic representation of existing noise exposures during daily activities in primary schools, especially for children. However, the noise is strongly dependent on the daily activities carried out by the teachers and children present in the examined educational buildings. For example, silent work will have significantly lower noise levels than group work. This work proposes a method to describe in-situ acoustic settings within different types of activities objectively. Two concepts on how to differentiate the activity-based acoustic settings are presented and evaluated using psychoacoustic parameters versus the traditional noise assessment parameter, A-weighted sound pressure level. The parameters are obtained from standard and binaural measurement methods. The focus in this work is to add children's point of view into the evaluation by integrating measurements using a child artificial head.

34018 - The specific demands of people on the acoustic environment in working status with complex cognitive tasks

4. Effects of noise on cognition, performance and behaviour
Keywords: healthy acoustic environment, subjective demands, complex cognitive tasks
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Noise has been proved to be a psychophysical stressor which impairs the cognitive process. Creating a healthy acoustic environment is particularly important for people's health and well-being. According to the former study, a healthy acoustic environment was defined as a demands-focused concept and the specific demands were proved to be closely associated with status. Based on the finding, the aim of this study is to further explore people's subjective demands on the acoustic environment in working status with complex cognitive tasks, such as comprehensive reading and complex calculations. Through focus group interviews, 81 specific demands were obtained. Afterwards, a big-sample questionnaire survey was conducted to screen out demands needed by most people. The results showed people's detailed demands and necessary evaluation dimensions on a healthy acoustic environment in working status with complex cognitive tasks. In particular, the screened demands lay a foundation of basic data set for a future laboratory experiment to further propose a standardized questionnaire of the healthy acoustic environment in working status with complex cognitive tasks.

34033 - Just noticeable difference of ISO 3382-3 metrics for open-plan office noise

4. Effects of noise on cognition, performance and behaviour
Keywords: Open-plan office, Just noticeable difference, Single number quantity, Auditory test, Perception
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In this study, the sound environment characteristics of open-plan office (OPO) were investigated, and just noticeable difference (JND) of the single number quantity ($L_{p,A,S,4m}$, $D_{2,S}$, and r_D) specified in ISO 3382-3 was suggested. First, in order to investigate the general sound environment characteristics of OPOs, one minute sound sources were collected for various English-speaking and Korean-speaking offices, and physical acoustic characteristics and psychological acoustic characteristics (sound quality and autocorrelation function) were analyzed. Through subjective evaluation, noise source identification, perceived affective quality, speech privacy, and work satisfaction were investigated, and a perception model for OPO sound environment was proposed. To investigate the JND of a single number quantity, actual measurements were conducted at two OPOs located in Korea, and the similar sound environment model was implemented through computer simulation. For the sound sources generated by different combinations for each single number quantity, the JND for the single number quantity was presented by performing paired comparison to the subjects. It is expected that the findings of this study can be used to classify the sound environment of OPOs.

34037 - The value of control for acoustics in open plan offices: a case study

4. Effects of noise on cognition, performance and behaviour
Keywords: open-plan offices, control, acoustic satisfaction, noise
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Acoustic conditions were investigated on two different floor plate designs managed by one organisation within one building. One is a traditional layout, with assigned desks arranged in rows. The other is a complete re-design within the same building for activity based working (ABW), with a variety of work settings, without assigned places. Both floor plates have the same ceiling, lighting, flooring, facade, and HVAC systems; both floor plates are open to the same central atrium. The organisation's staff surveys demonstrate a significant improvement in satisfaction with environmental conditions for thermal comfort, lighting, and acoustics for people on the ABW floorplate. This study investigated the acoustic conditions on the two different floor plates.

Measurements of the room acoustics were conducted according to ISO 3382-3, revealing very similar indicators. Occupied acoustic measurements demonstrate that the in-situ acoustic environment is also similar between the two designs, although more varied on the ABW floor plate. The improvement in satisfaction with the acoustic conditions is ascribed to the increased control that people have over their work environment, explored through interviews.

34052 - Traffic noise and violent crime: empirical evidence from England

4. Effects of noise on cognition, performance and behaviour
Keywords: Violent crimes, Traffic noise, Noise action plans, Public security
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Despite the vast research on traffic noise exposure's physical and mental outcomes, little is known about its effect on violent crimes. To explore this question, we compared the number of violent crimes in areas targeted by the second-round noise action plans (adopted by DEFRA in 2014), to that in untargeted areas before and after the intervention in 2012-2017. The noise data and exact locations of areas treated by noise action plans were extracted from the Strategic Noise Mapping database, and crime records were obtained from the Street-level Crime database. We aggregated these data and other control variables at a small neighbourhood level (lower layer super output areas, or LSOAs) for England. The results of the Poisson random-effects models showed a 7.5% reduction in average ambient traffic noise category and 2.86% less violent crime after the intervention compared to untreated areas between 2012-2017. We found no reduction in violence in placebo areas with high traffic noise levels but no relevant noise-reduction interventions. Overall, we conclude that traffic noise exposure is likely to lead to violent crime.

5. Effects of noise on sleep

26112 - Effects of chronotype, noise sensitivity and spindle density on traffic noise-induced changes of sleep depth and stability

5. Effects of noise on sleep
Keywords: traffic noise, polysomnography, laboratory study, sleep depth
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Traffic noise can lead to cortical and autonomic activation, disrupt sleep and impair physical and mental restoration. We investigated the effects of individual-level factors (chronotype, noise sensitivity, EEG spindle density) on noise-induced changes of sleep depth and quality. Seventy-two healthy participants slept for 11 nights in a laboratory. In 8 nights, participants were exposed to 40, 80 or 120 road, rail and/or aircraft noise events at 45-65 dB $L_{AS,max}$. Sleep was measured with polysomnography. Sleep depth was scored as the odds ratio product (ORP), a continuous measure based on automatic analysis of physiologic sleep data in 3-second epochs. Data were analysed in random intercept generalized linear mixed models adjusted for experimental- and individual-level covariates. We found significant effects of chronotype and spindle density on some noise-free sleep and whole-night ORP sleep measures. There were dose-response relationships between traffic noise and elevations of ORP, although these were not significantly affected by chronotype or spindle density. There were no effects of noise sensitivity on any investigated whole-night or event-related ORP measures. These findings and their implications will be discussed at the congress.

27397 - A comparison of cardiovascular activation responses to environmental noise during sleep

5. Effects of noise on sleep
Keywords: pulse wave amplitude, sleep disturbance, cardiovascular marker, environmental noise
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Frequent cardiovascular activation responses associated with micro-arousals and sub-cortical sensory processes may negatively impact on cardiovascular health. Therefore, simple measures such as pulse wave amplitude (PWA) and heart rate (HR) may be simple sensitive cardiovascular markers of sleep disturbance to environmental noise. This study sought to compare the magnitude of automated measures of PWA and HR to noise presentations during sleep.

Twenty-five participants attended a sleep laboratory for one overnight recording of electroencephalogram, electrocardiogram (ECG) and finger pulse oximetry. Randomised 20-second noise batteries of multiple types of noise were played at different sound pressure levels (SPLs) (33-48 dB(A)) during established N2 and N3 sleep. Automated measures of HR and PWA were derived from ECG and oximetry signals and compared between noise levels and types using response-free survival analysis.

The principal findings support that noise stimuli induced a more prominent and reliable PWA response compared to HR responses. SPLs, noise type and sleep stage all influenced PWA responses due to noise. These findings support that relatively simple automated markers of cardiovascular activation responses, particularly PWA, provide useful markers of sleep disturbance.

28334 - Exposure response-relationships between nocturnal aircraft noise and sleep disturbances in primary school children

5. Effects of noise on sleep
Keywords: nocturnal aircraft noise, sleep, children, field study, polysomnography
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Although undisturbed sleep is widely regarded as essential for physical and psychological development in children and aircraft noise is an evidenced source for sleep disturbances, little knowledge exists about its impact on childhood sleep. We investigated sleep in a field study of 51 children aged 8 to 10 years who resided near a 24-h operating airport. Sleep was measured polysomnographically during four nights with the first night used as adaptation night. Aircraft noise exposure was recorded simultaneously at the children's ear so that exposure-response models for awakening reactions could be computed from event-related analyses. Relevant predictors of an awakening were both of acoustical (e.g., maximum level of aircraft noise event, level of the background noise, maximum rise rate of level increase), and situational/non-acoustical nature (e.g., elapsed sleep time, sleep stage preceding the aircraft noise event, presence of worrying events in the near past or future). A comparison of the resulting exposure-response curve to an established curve for adults from the same airport region revealed a higher wake-up threshold to aircraft noise events in children.

28466 - Noise sensitivity is associated with nonrestorative sleep but not with physiological sleep parameters

5. Effects of noise on sleep
Keywords: nocturnal noise, noise sensitivity, nonrestorative sleep
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Background and Objective: Current assessment of the association between noise sensitivity and nonrestorative sleep (NRS) lacks adjustment for important confounders, validated NRS measures or nocturnal noise assessment. This study aimed to properly assess the association of noise sensitivity with NRS and physiological sleep parameters.

Methods: We conducted a representative household study of 500 adults with no treatment for hearing or sleep problems. One-week nocturnal noise and actigraphy were measured and a battery of standardized questionnaires including the Weinstein Noise Sensitivity Scale (WNSS, 0-100) and Nonrestorative Sleep Scale (NRSS, 0-100), was administered.

Results: The 500 adults (66% female, mean age=39 years) had mean WNSS=60.4, NRSS=64.8, nocturnal noise level=51.3dBA, total time in bed=441min, and total sleep time=345min. After adjusting for demographics, lifestyles, social support, anxiety, depression, stress, somatic symptoms, and nocturnal noise, 1 unit higher in WNSS (higher noise sensitivity) was associated with 0.1 (95% CI: 0.01, 0.15, p=0.025) lower magnitude in NRSS (more NRS), but not with the total time in bed (p=0.604) and the total sleep time (p=0.835).

Conclusion: People complaining of nonrestorative sleep may need assessment of noise sensitivity.

28472 - Experimental Study on Effect of Background Noise on Deep Sleep

5. Effects of noise on sleep
Keywords: Background noise, Deep sleep, Silent room, Residential noise environment, EEG brainwave monitoring
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In this study, how the ambient noise affects deep sleep at night sleep is explored by a contrast experiment. 35 adults of different ages and genders participated in. The ambient noise in subjects bedroom at home is 22.2dBA ~ 48.0dBA. The ambient noise in the silence room is lower than 5dBA even with the air conditioning system on. All the subjects sleep at "0dB Silence Room" and home bedroom for one night each wearing the electroencephalo-graph (EEG) monitor called Zeo. By analyzing the sleep data of each night from Zeo, the results shows that between 22 and 31 dBA, as the noise increases, the length of deep sleep would increase too; and at 31dBA, the deep sleep length reaches the length peak; and between 31 and 48dBA, as the noise increases, the length of deep sleep would linearly decrease, by 4% for each additional 1 dB noise. Conclusively, the best ambient noise level at home bedroom exist rather than the lower the better.

28587 - The ANIMA project: Standard exposure-response model for aircraft noise-induced awakening reactions: Suggestions for physiology based night noise protection zones

5. Effects of noise on sleep
Keywords: sleep disturbance, polysomnography, exposure-response curve, night noise protection, noise policy
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Sleep disturbance is the main negative effect of nocturnal aircraft noise, known to increase the risks of adverse health effects and impair the quality of life. Protection zones for nocturnal aircraft noise are currently based mostly just on average sound levels. However, these physical measures usually correlate poorly with sleep quality. In order to develop a generalizable standard exposure-response model, within the EU-project ANIMA a re-analysis of the two worldwide available field studies using the gold standard polysomnography and simultaneous acoustical measures was carried out. Pooling of the data was performed to get a medium exposure-response curve based on the AIC. For a standard model, additional parameters should be considered, premised they do not significantly deplete the AIC. Exposure-response curves for the pooled and standard model will be presented and compared. Results provide valuable information on new night noise protection concepts, based on physiological measures. The application of the model in ANIMA's Virtual Community tool, a software to compute additional aircraft noise induced awakenings around airports, will also be presented.

28685 - Study Design and Power Calculations for a National Study on the Effects of Aircraft Noise on Sleep around 77 Airports in the United States

5. Effects of noise on sleep
Keywords: sleep, noise, field study, awakening, heart rate
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Aircraft noise can disrupt sleep and impair recuperation. The last U.S. investigation on the effects of aircraft noise on sleep was conducted more than 20 years ago. Since then, traffic patterns and noise levels produced by single aircraft have changed substantially. It is therefore important that field studies be conducted in the U.S. to acquire current data on sleep disturbance relative to varying degrees of aircraft noise exposure. Study designs used during two pilot field studies around Philadelphia and Atlanta airports were adapted and refined for this National Sleep Study. The research methodology, acquiring acoustical and physiological data (heart rate and body movements) with no investigator on site and equipment mailed to participants, was found to be feasible. Power calculations were conducted using simulations of expected sleep period times and 2018 air traffic density data, and determined the need for investigating 400 participants for 5 consecutive nights around 77 airports with relevant amounts of nighttime air traffic. This study will provide key insights into the effects of aircraft noise on objectively and subjectively assessed sleep disturbance.

28776 - Aircraft noise exposure and subjective sleep quality in the DEBATS longitudinal study

5. Effects of noise on sleep
Keywords: epidemiology, aircraft noise exposure, health, subjective sleep quality
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Aircraft noise exposure is known to impact human health, in particular sleep.

We aimed to characterize the influence of aircraft noise on subjective sleep quality.

The DEBATS study included 1,235 participants living near three French major airports. Participants answered in 2013, 2015 and 2017 detailed face-to-face interview. Outdoor aircraft noise levels were estimated at each home address using noise maps. Longitudinal analyses were performed using logistic mixed models adjusted on potential confounders.

In 2013, 9% of the participants had a short total sleep time (≤ 6h) (respectively 8% in 2015 and 6% in 2017) while 30% felt rather or very tired on awakening in 2013 (24% in 2015 and 23% in 2017). A 10dB(A) increase in L_{den} levels was associated with a short total sleep time (OR=3.1; 95% confidence interval: 2.1-4.5) and with a feeling of tiredness on awakening (OR=1.3; 95%CI: 1.0-1.6).

In our longitudinal study, increased aircraft noise exposure was associated with decreased subjective sleep quality. Nevertheless, effects of annoyance due to aircraft noise and noise sensitivity must be investigated as they could mediate or moderate the observed associations.

28888 - Effects of environmental noise on sleep through the lens of the K-complex

5. Effects of noise on sleep
Keywords: sensory processing, sleep, K-complex, noise sensitivity
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Brain electrical activity recorded via an electroencephalogram (EEG) is very useful for assessing sleep and sensory disturbances during sleep. The aim of this study was to test for potential dose-response relationships between environmental noises and the K-complex (KC), a subtle marker of sensory processing during sleep.

Twenty-five participants completed full sleep study recordings, including EEG. Environmental noises of 20 seconds duration and 5 different types were played at different sound pressure levels (SPL) (33-48 dB(A)) throughout the night during established N2 and N3 sleep. The relationship between the probability of occurrence of a KC and SPL (or noise type); as well as the effect of participant noise sensitivity (based on the Weinstein Noise Sensitivity Scale) on K-complexes occurrences were examined.

Higher sound pressure levels were more likely to elicit a K-complex (1.7% at 33 dBA and 19.6% at 48 dBA). No differences were observed between different noise types. Nonetheless, subjective noise sensitivity was a significant predictor of response probability. These findings support that KCs are a useful marker of noise-related sleep disturbances, with a higher response probability in noise-sensitive participants.

28889 - Simultaneous recording of subjective sleep disturbance and wind farm noise over one year

5. Effects of noise on sleep
Keywords: wind farm noise, amplitude modulation, sleep disturbance
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There have been widespread reports that wind farm noise can cause sleep disturbance. However, it is unknown how often this disturbance takes place, the typical duration of noise events and the characteristics of the disturbing noise. To develop further understanding in this area, simultaneous measurements of outdoor and indoor noise were taken over one year at a residence located approximately 900 m from the nearest wind turbine. The measurement room was unoccupied, and its windows faced the nearest wind turbine. Residents occupied the adjacent room, which had the same orientation. One of these residents, who reports regular disturbance from wind farm noise, kept regular noise and sleep diaries. Over one year, the resident reported noise-induced sleep disturbance from the wind farm on 30% of nights. He described the noise as a “swish” and/or “woosh” for 80% of the time and as a “rumble” for 10% of the time, among other descriptors. Analysis of the noise data using the Institute of Acoustics amplitude modulation (AM) detection and quantification algorithm revealed that AM was regularly present when the resident reported disturbance.

28925 - A review of research on the effects of noise on sleep from 2017-2020

5. Effects of noise on sleep
Keywords: noise, sleep, insomnia, awakenings, night-time
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Sufficient sleep is important for cognitive functioning, as well as for good mental and physical health. To provide an overview of recent findings on the effects of noise on sleep, a literature review was conducted. Articles published since June 2017 were identified through a search in scientific databases. Studies on transportation, wind turbine, and hospital noise were included in this review. One major effort in this period was the comprehensive and systematic review to update the exposure-response associations for environmental noise and both self-reported and physiologically measured sleep, as the basis for the development of the WHO noise guidelines. Other, population based studies have been published during this period, including studies on the effects on wind turbine noise on sleep medication use and effects of road traffic noise on children's sleep. There has been an ongoing interest in acute physiologic effects of noise on sleep. Among the several field studies on aircraft noise is the first investigation on children. Research has continued into the mechanisms linking noise-induced sleep disruption with the development of disease, in both human and animal studies.

34031 - Experimental investigation on sleep disturbance for transportation noise – follow-up test of the noise effect on sleep using recorded traffic noise.

5. Effects of noise on sleep
Keywords: experimental study, traffic noise, self-reports, actimetry method
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In this study, we investigate how noise affect sleep using recorded traffic noise in participants' own home. A road traffic noise, a conventional railway noise and an aircraft noise were used in this experimental study. Participants were mainly collected from the students of our university. Participants were exposed to the artificially controlled traffic noise all night long using portable CD player which was set on repeat. The sleep disturbance for traffic noise was evaluated in the following two manners: self-reported sleep quality based on questionnaire and the measurement of body movement using wrist actimetry method. The relationships among subjective sleep disturbance, kinds of traffic noise, noise sensitivity and noise level were analyzed through several statistical test. On the other hands, objective sleep disturbance was evaluated according to how frequently bodily reactions happen to traffic noise events. In this paper, we report the relationship between subjective and objective sleep disturbance, and that between noise level and incidence of waking after sleep onset (WASO).

34042 - Association between road traffic noise exposure and sleep problems in children

5. Effects of noise on sleep
Keywords: child, sleep, actigraphy, road traffic noise, environment
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We aimed to examine the association between road traffic noise exposure and subjectively and objectively measured sleep problems in children at 10-11 years old from the Spanish INMA Project. Average 24h road traffic noise exposure (L_{DEN}) during the year before of the sleep assessment was estimated at each participant' addresses using EU noise maps. Sleep problems were assessed using both maternal-reported (n=204) and wrist-actigraphy during 7 days (n=133). Average L_{DEN} levels were 61.2 decibels (dB) (SD 5.9). No associations were found between L_{DEN} and maternal-reported sleep problems. Wrist-actigraphy data revealed that higher L_{DEN} was associated with reduced sleep latency onset, reduced sleep efficiency ratio, higher wake time after sleep onset, and shorter sleep duration (e.g. -0.18 hours of sleep duration (95% CI: -0.24, -0.12) per 5dB increase in noise and -17.14% (95% CI: -21.7, -12.6) in sleep efficiency per 5dB increase in noise). However, these associations were not observed after adjusting for confounding variables. Our study did not find an association between road traffic noise exposure and sleep problems in children. Replication studies with large sample size are warranted.

6. Community response to noise and noise annoyance

28329 - Using soundscape assessment tools to determine the impact of industrial noise in quiet areas

6. Community response to noise and noise annoyance
Keywords: soundscape, industrial noise, tranquillity
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Soundscape assessment tools are used to investigate the impact of industrial noise in quiet areas. The conservation of quiet areas is encouraged due to their positive effects on health. However, typically the assessment of industrial noise neither promotes the conservation of quiet areas nor quantifies the impact on the restorative qualities of natural soundscapes. Assessing industrial noise with soundscape tools could allow for the consideration of context and the impact on restorative qualities.

Soundwalks were conducted in accordance with ISO 12913-2 with eleven participants in a remote part of Scotland both with and without an industrial source present. The effects of context are found to be key to the impact of industrial noise and, contrary to guidance, intrusiveness is no less relevant in low background sound level environments. Naturalness as a perceived affective rating scale was found to be the principal component of variance, accounting for 29%, despite not being recommended in ISO 12913-2. The centre of gravity and music-likeness, objective metrics that could allow for simplified identification of natural soundscapes, are not found to be reliable indicators.

28518 - Annoyance from road traffic noise has NOT changed. The annoyance reactions have been stable across the past five decades.

6. Community response to noise and noise annoyance
Keywords: road traffic, annoyance
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A detailed analysis of more than 60 surveys on road traffic noise conducted world-wide across the last five decades shows that there has been no change in people's reactions to this type of noise. The prevalence of highly annoyed residents has been stable, and an analysis of 18 post-2000 surveys confirms that the exposure-response function derived by Miedema and Vos (1998) is still valid. The recommendation by WHO to lower the acceptable limit to avoid adverse health effects is not supported by existing evdence.

28619 - Research on community response to noise 2017 to 2021

6. Community response to noise and noise annoyance
Keywords: Team 6 activities, community response to noise, review
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This contribution presents a review of the research progress on community response to noise in the years 2017 to 2021. The majority of the studies deals with environmental noise or soundscape in general followed by transportation noise (separately and increasingly combined). In addition to noise annoyance, the main criteria are soundscape perception and health effects. Methodologically, there is an increase in the use of virtual reality devices. Further studies refer to the momentary assessment of short-term sound perception (noise, soundscape). Recently published studies predominantly support the assumption of an increase in transportation noise annoyance over time. Some studies investigated exposure metrics as supplements to average sound levels; others introduced new annoyance scales. Attention is drawn to non-acoustic factors that potentially affect noise responses, e.g. attitudes, other exposures, restorative environment. Also, within the 4-years period 2017 to 2021, a systematic review on environmental noise annoyance that informed among others the Environmental Noise Guidelines of the World Health Organization was published. These and other findings are discussed.

28632 - Impact of noise source and acoustical metric on noise annoyance due to nighttime traffic

6. Community response to noise and noise annoyance
Keywords: noise annoyance, nighttime traffic, exposure-response relationship
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Since there is a lack of comparable exposure-response relationships between traffic noise and annoyance, we explored the effect of different traffic noise sources assessed by precise measurements of noise parameters in the field. We compared the data of a current study on road traffic noise (N = 40) with those of two earlier studies on railway (N = 33) and aircraft noise (N = 64). Participants rated their annoyance due to nighttime traffic noise exposure on the five-point ICBEN scale. The acoustic measurements were undertaken inside the bedroom. A generalized estimating equation model concerning the energy equivalent sound pressure level revealed that road traffic noise was more likely to induce annoyance than air traffic noise ($p = .001$). A second model adjusting for the number of traffic noise events indicated that railway noise was more annoying than air traffic ($p = .032$). The present study emphasizes that annoyance varies in both the noise source and the acoustical metric. This might be explained by different acoustical properties of traffic modes and by different temporal patterns of noise distribution throughout the night.

28643 - Do positive and negative affect depend on chronic exposure to road traffic noise? Results from a cross-sectional study among older residents

6. Community response to noise and noise annoyance
Keywords: residential exposure, road traffic noise, positive affect, negative affect
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Chronic exposure to traffic noise (TN) has been related to negative emotional states. Yet, evidence on distinct dimensions of emotional well-being like positive and negative affect (PA, NA) is lacking despite their relevance for premature mortality. We investigated the associations of road TN with PA and NA in participants (60–90 years) from a cohort study in the German Ruhr Area in 2016. PA and NA sum scores from a self-administered questionnaire (PANAS) ranged from 15 to 50 and 10 to 47 (PA median: 33, N=1773, NA median: 16, N=1784). TN at the most exposed façade of residents' address was retrieved from EU noise maps (L_{den}, ≤55 dB(A) (reference), medium >55-≤65 dB(A) and high >65dB(A)). We observed an age-adjusted inverse association of TN with PA (b_{medium}=-0.955, p= 0.0545, b_{high}=-2.188, p=0.0006) in a linear regression model, capturing potential gender differences by using interactions with TN exposure categories. The overall finding remained after further adjustments including noise sensitivity, room location, and social indicators. We could not confirm an association of TN with NA. Results indicate differential psychosocial mechanisms worthy of further exploration.

28661 - Does bedroom windows orientation contribute to annoyance and sleep disturbance? A questionnaire survey.

6. Community response to noise and noise annoyance
Keywords: questionnaire survey, noise annoyance, sleep disturbance, major Slovak cities, windows orientation
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Sleep disturbance and annoyance, mostly related to road traffic noise, comprise the main burden of environmental noise in Europe. This paper presents the results of a cross-sectional study - a questionnaire survey focused on those issues among the residents living in major Slovak towns including Bratislava and Kosice. Noise annoyance was subjectively assessed by a modified standardized questionnaire obtained electronically and by correspondence from 543 respondents, the average age was 45± 4 years, 53% females, 81% living in houses for more than five years. The questionnaire was supplemented by traffic noise-measurements on noisy and quiet facades ($L_{Aeq,day}$ = from 51.8 dB to 72.4 dB, $L_{Aeq,night}$= from 41.9 dB to 64 dB). Inhabitants from the exposed group with bedroom windows facing noisy streets are less satisfied with their quality of living, are less noise-sensitive and report more day and night annoyance and sleeplessness (OR=2.54; 95 % CI =1.38-4.92) than respondents with bedroom windows facing quiet streets. It is necessary to propose interim measures to noisy facades as well as intervention procedures and to apply the principles of healthy city planning.

28712 - Measuring Quality of Life in Communities Surrounding Airports

6. Community response to noise and noise annoyance
Keywords: Quality of life, non-acoustic, sociological
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Quality of Life (QOL) is a broad, multi-dimensional concept that refers to an individual's or community's perception of and actual well-being and position in life, encompassing many categories of variables including health, economics, environmental, psychological, social and other factors. The proposed QOL Assessment Methodology provides a flexible framework for airports (or other organizations) to collect data for 100 suggested indicators that span six categories of QOL and collectively contribute to overall QOL.

By evaluating the diverse components that comprise total QOL in their surrounding communities, airports can better understand how QOL is affected by different factors the airport directly controls; this can help foster improved relationships between airports and communities and allows for better planning.

28870 - On the association of residential green with road, railway and aircraft noise annoyance

6. Community response to noise and noise annoyance
Keywords: traffic noise, annoyance, vegetation, green
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Residential green has recently come into focus as a measure to reduce annoyance due to traffic noise exposure. Literature suggests that various indicators of residential green may be important, namely, "greenness" of the residential areas, visible vegetation, or the presence of functional green spaces such as urban parks. Accessibility and noise pollution of the latter may also play a role. So far, studies mostly focused on road traffic noise. The objective of the present study was to investigate the effects of residential green on noise annoyance at a national scale, accounting for different transportation noise sources. We complemented the data set of the recent Swiss SiRENE survey on road traffic, railway and aircraft noise annoyance with a range of green indicators and investigated their association with noise annoyance. In this contribution, we will reveal the most promising green indicators. We will further show that exposure to residential green is positively associated with reduced noise annoyance to road traffic and railway noise, but strongly linked to increased annoyance to aircraft noise.

28877 - Surveys of occupants of new apartment buildings in the United States of America

6. Community response to noise and noise annoyance
Keywords: building acoustics, survey, apartments
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A large developer of multifamily residential projects in the USA gives a standard survey to occupants of newly constructed buildings. The survey includes a numerical rating of the "sound proofing" of the apartment, along with a free-response question regarding any acoustical issues. Although not necessarily representative of older multifamily housing stock in the USA, the surveyed projects are from a variety of geographical regions and markets, and include both concrete and wood structural systems with a range of acoustical performance. So far over 600 responses in 10 buildings have been analyzed. The responses characterize the types of acoustical issues that are most commonly reported, and are analyzed with respect to the assembly design and market expectations.

28886 - A Comprehensive Survey on Noise Annoyance from Construction and Domestic Renovation

6. Community response to noise and noise annoyance
Keywords: Socio-acoustic survey, noise annoyance, construction, domestic renovation
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Construction noise is of particular concern in the densely populated Hong Kong, due to the close proximity of residential buildings to new developments or redevelopments, as well as domestic renovation activities within those high-rise and multi-flatted buildings. As part of the review on construction noise control in Hong Kong, a public survey with more than 5,000 households over the territory was conducted. This socio-acoustic survey was the first of its kind and its scale in Hong Kong, and was specifically designed for gauging public opinions related to construction noise and domestic renovation noise. It was done with reference to ISO/TS 15666:2003 on assessment of noise annoyance, and a high response rate of 76% was achieved through face-to-face interviews. This paper will give an account of the design and methodology adopted in the survey, and its key findings and implications to possible options in improving the noise environment near construction sites or domestic flats under renovation.

28914 - How aircraft noise impact management can improve residents' quality of life – A field study

6. Community response to noise and noise annoyance
Keywords: ANIMA, aircraft noise, intervention, quality of life
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The EU research project Aviation Noise Impact Management through Novel Approaches (ANIMA) aims to develop new methods and instruments for reducing aircraft noise impact and enhancing the quality of life (QoL) of residents near airports. The focus of the current study is to identify those aspects that improve residents' QoL, based on existing interventions implemented by airports, the aviation industry, or public authorities. Four different European Airport regions (in France, Germany, The Netherlands, and UK) were chosen to investigate the impact of different interventions, such as sound insulation schemes and a dialogue forum, on residents' QoL. Focus groups and in-depth interviews were carried out at three airport locations to get a comprehensive and thorough understanding of the specific interventions, if and how these are perceived by residents, and which aspects of these interventions have an impact on their QoL. Further, existing data from a survey conducted around Schiphol Airport was re-analysed, indicating which aspects of residents' living environment are most relevant comparing three different contours. In this contribution, the procedure and the results of the study are described and discussed.

28917 - Measuring short-term noise annoyance to determine the impact of low sonic boom noise

6. Community response to noise and noise annoyance
Keywords: short-term annoyance, super sonic boom, aircraft noise
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Supersonic flights allow a significant reduction of travel time on long journeys. However, the strong impact of supersonic boom on community responses to noise is well known. A new generation of supersonic planes is designed to distinctively lower the acoustical impact of sonic booms on the ground. It is unknown how people living underneath a flight route react to this new low supersonic boom. The Horizon 2020 project RUMBLE gathers ideas and approaches to set up regulations for new supersonic planes. Within the next years it is attempted to conduct test flights with new supersonic plane demonstrators. Further on, it is intended to use these test flights to conduct a field study on the impact of the new low sonic boom on residents living underneath the flight route. Within the RUMBLE project we have developed a concept for the assessment of en-route short-term annoyance of the exposed population by means of the experience sampling method. The concept will be presented and discussed with regard to similarities and differences between short-term and long-term annoyance assessments and its potential contributors.

28950 - Effects of the railway category and noise on vibration annoyance

6. Community response to noise and noise annoyance
Keywords: Railway category, Noise, Vibration, Annoyance, Logistic regression analysis
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Railway-induced noise and vibration in buildings cause adverse physiological and psychological effects on people in urban districts. Annoyance due to noise and vibration from railway has been investigated by using the methods of socio-acoustic surveys and subjective evaluation experiments. A Japanese previous survey revealed that community response to noise differed according to the following railway categories: the Shinkansen and conventional railways. Inhabitants have negative attitudes to noise from the Shinkansen railway and do not recognize the necessity of the noise source. Therefore, the Shinkansen railway leads to greater noise annoyance than conventional railway. In addition, many researchers have addressed the mutual effect of noise and vibration produced by trains on annoyance. However, quantitative method to evaluate the mutual effect has not been fully established. Applying a multiple logistic regression analysis to the Japanese datasets, the authors tried to provide quantitatively the effects of railway categories and noise on vibration annoyance. Based on the obtained results, we discuss the combined effects of railway noise and vibrations on annoyance.

28986 - Different measures of noise sensitivity and annoyance to aeroplane noise

6. Community response to noise and noise annoyance
Keywords: Noise sensitivity, noise annoyance, aeroplane noise, temporal structure
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Noise sensitivity moderates the association between environmental noise and annoyance and health outcomes. In normally-hearing adults, we measured noise sensitivity in three ways: using the Noise Sensitivity Questionnaire (NoiSeQ), a three-point self-rating, and the Loudness Discomfort Level (LDL; mean discomfort level for tonebursts). We then presented recordings of a 15-second 80 dBA Leq aeroplane overflight, and participants rated the annoyance and loudness. The three measures of noise sensitivity were not well correlated with each other, and only the overall LDL was associated with the ratings of loudness and annoyance. This implies that current measures of noise sensitivity may only capture parts of the underlying construct, and therefore underestimate its effects on the association between environmental noise and annoyance and health outcomes. We developed a theoretical model to describe the factors that may influence a person's sensitivity to noise and propose that this is the basis for noise sensitivity. This paradigm alters the focus of noise research from the annoyance caused by the sound to the sensitisation to noise that may occur as a result of the interplay of many factors.

28993 - Traffic noise and annoyance in a Swedish context

6. Community response to noise and noise annoyance
Keywords: Traffic noise, annoyance, exposure-response, moderating factors
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Source specific exposure-response functions for traffic noise and annoyance have been developed within the framework of the WHO Environmental Noise Guidelines 2018. These functions can be valuable tools within health impact assessments. However, local conditions may affect their validity. In this study, we aim to compare the established exposure-response functions for traffic noise and annoyance to similar curves developed within a Swedish sample. Furthermore, we explore the response in annoyance according to several moderating factors. The analyses are based on 12 360 responders from the Environmental Health Questionnaire 2015. Exposure to road and railway noise was modelled using a simplified version of the Nordic Prediction Method. For aircraft noise, data was obtained from Swedavia. The results show that the 10 % benchmark for %HA is reached at 52, 61 and 44 dB dB L_{den} for road, railway and aircraft noise, respectively. This corresponds well to the WHO curves for road and aircraft (53 and 45 dB L_{den}, respectively), but not for railway noise (54 dB L_{den}). Moderating effects on annoyance was found for building type, year of construction and apartment orientation.

29022 - Utilizing the percentile Lasso to identify variables that influence retrospective judgments of everyday sounds

6. Community response to noise and noise annoyance
Keywords: environmental sound; annoyance; online survey; acoustic environment; non-auditory factors
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We conducted a large-scale online study to investigate which situational, sound- and person-related variables drive people's annoyance caused by low-level (i.e., quiet) sounds in everyday life. Therefore, 1,301 participants reported in retrospection 2,800 sounds using free-text descriptions and rated them regarding several potential influencing parameters. The percentile Least Absolute Shrinkage and Selection Operator (Lasso) regularization method selected essential variables constituting a comprehensive linear mixed-effects regression model, which explained 68% of annoyance overall. The most important situational parameters were emotional valence and arousal, situational positivity, and the perceived ability to mentally fade-out the sound in the specific situation. Crucial sound-related parameters selected by the Lasso were the sound category (natural, human, and technical) and the perceived loudness. Interestingly, all person-related variables were eliminated by the Lasso, including noise sensitivity, which has been identified as a major influencing factor in previous studies. Our study results are regarded a starting point to establish further comprehensive psychological models predicting sound evaluations in everyday life.

29035 - Assessment of noise mitigation approaches along the construction site of a major highway in an urban environment

6. Community response to noise and noise annoyance
Keywords: Traffic noise, annoyance, noise mitigation, construction noise
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Environmental noise can affect health. It might be associated with annoyance, sleep disorders, cardiovascular problems and communication problems. So far, few studies have been conducted regarding noise annoyance to large road infrastructure construction sites. In this study, 1409 residents were interviewed to assess various noise mitigation approaches to reduce noise annoyance (temporary noise barriers, wideband backup alarms, online noise monitoring, construction site surveillance, citizens' committee, etc.). A multivariate regression analysis showed that 10% of the variance of the construction noise annoyance is accounted for by the perception that temporary noise barriers effectively reduce noise propagation, road traffic management, construction site surveillance and dust controlling within the construction site. Other aspects such as physical appearance of the temporary noise barriers, actions of the citizens' committees and use of wideband backup alarms did not significantly predict noise annoyance. Implications for construction noise management will be discussed.

29040 - Applying the Brown and van Kamp (2017) protocol to a diffractor wall intervention study in The Netherlands: Finetuning of the protocol and methodological and practical issues.

6. Community response to noise and noise annoyance
Keywords: intervention, noise annoyance, well-being, excess response, road traffic noise
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Elise van Kempen[1], Eefje Joosten[1], Wim Swart[1], Irene van Kamp[1]
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Interventions to reduce noise levels and negative impacts of noise are applied on a large scale. Although estimations of noise reduction per intervention are regularly made, only few studies of sufficient quality have been published on the effects of these interventions on annoyance, health and well-being. This was one of the key conclusions in the WHO-review by Brown and van Kamp (2017). To evaluate the effects of the placement of a diffractor wall alongside a busy traffic artery in the Province of Utrecht (The Netherlands), a before-after study was designed using the protocol proposed by Brown and van Kamp. Modeled and measured sound levels are combined with a questionnaire survey before and twice after the intervention. The questionnaire addresses key health outcomes as well as personal and contextual variables, such as noise sensitivity, attitudes and coping behavior. In this presentation the study protocol and methodological and practical issues for intervention studies will be addressed.

29073 - Does the community response to noise change? A follow-up investigation on the impact of aircraft noise around Tan Son Nhat Airport after 11 years

6. Community response to noise and noise annoyance
Keywords: .
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A representative exposure–response relationship for aircraft noise annoyance in Vietnam was established partly based on data obtained from a social survey on community response to aircraft noise were carried out around Tan Son Nhat International Airport (TIA), Vietnam's largest airport, in 2008. The question is whether the response to noise change thought out the time and if the established relationship is suitable for the present consideration for future aircraft noise regulations. This study provided a comparison between the previous survey in 2008 and the recent investigation on noise impact conducted at the same residential areas near TIA in 2019. The average flight number increased from 200 in 2008 to more than 720 in 2019. Accordingly, the day-evening-night noise level (L_{den}) ranged from 53 to 71 dB and from 63 to 81 in 2008 and 2019, respectively. The percentage of highly annoyed respondents in an area of above 70 dB (L_{den}) was 52% in the 2008 survey, while this number only 12 percent in the 2019 survey. The residents living in the noisier environment seem to be more tolerant of noise.

33692 - Identifying factors contributing to annoyance from neighbourhood noise

6. Community response to noise and noise annoyance
Keywords: noise annoyance, neighbourhood noise, non-acoustic factors
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Studies have shown that neighbourhood noise is the second most annoying noise source in Germany, but little is known about the characteristics that affect the annoyance ratings of neighbourhood noise. In a population-representative survey commissioned by the German Environment Agency, we examined noise annoyance due to various noise sources in Germany. For neighbourhood noise, relevant characteristics and factors that potentially contribute to the annoyance ratings were examined.

In total, four representative areas in Germany were selected. Each area was stratified according to its density of agglomeration (inner city, urban fringe, rural area). A mixed-method design was used. First, neighbourhood noise was qualitatively assessed by means of focus groups. In a second step, a questionnaire study was conducted. In total, 1,972 questionnaires (online and paper-pencil) were filled in.

In this paper, we investigate the influence of different non-acoustical factors contributing to neighbourhood noise annoyance judgments, e.g. density of agglomeration, house type, relationship to neighbours, satisfaction with the neighbourhood, one's own perception as a causer of noise, and annoyance due to other noise sources. Results will be discussed.

33788 - Revising ISO/TS 15666 – the noise annoyance standard

6. Community response to noise and noise annoyance
Keywords: annoyance, research gaps, community response, exposure-response
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Noise annoyance is the most prevalent community response in populations exposed to environmental noise. In 1993 the ICBEN Community Response to Noise team started work formalizing a standardized methodology for assessing noise annoyance, which resulted in reporting guidelines and recommendations for standard questions, which was later published by the International Standards Organization as a Technical Standard in 2003 (ISO/TS 15666: 2003). This Technical Standard is used to quantify exposure-response relationships between noise exposure and annoyance internationally. ISO/TS 15666 has now been in operation for nearly two decades. This paper will report on the work of an international working group, tasked with revising and updating the Technical Standard. This paper will review use of the Technical Standard; discuss its revision; and highlight research needs and gaps that, if addressed, would help to further strengthen the methodology underlying the assessment of noise annoyance.

33974 - Testing of total noise annoyance models using field data and a methodology for taking psychoacoustic indices into account: improvement compared to models solely based on Lden

6. Community response to noise and noise annoyance
Keywords: combined noise sources; annoyance prediction
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Various studies have shown that L_{den} is not sufficient to account for noise annoyance in urban areas. Indeed, noise annoyance is influenced by various acoustic (*e.g.* spectral distribution of energy) and non-acoustic factors (*e.g*. noise sensitivity). Noise annoyance models based on noise sensitivity and psychoacoustic indices have been proposed in the literature from laboratory experiments. It would be interesting to test the relevance of these models using in-field noise annoyance and noise sensitivity data. The difficulty lies in the absence of the values of psychoacoustic indices in database built from socio-acoustic surveys. To overcome this problem, a methodology has been proposed to estimate psychoacoustic index values. Then, the models were tested using in-field data from a socio-acoustic survey dealing with combined road traffic and aircraft noise sources. The results show that these models, based on psychoacoustic indices and noise sensitivity, make it possible to better predict both partial and total annoyance compared to models solely based on L_{den}. They also highlighted the advantage of perceptual total annoyance models using predicted partial annoyance responses compared to psychophysical ones.

33975 - Cross-cultural laboratory study on combined noise and vibration of Shinkansen pass-by

6. Community response to noise and noise annoyance
Keywords: railway annoyance; cross-cultural study; combined noise and vibration exposure; activity disturbance
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In European field studies, annoyance due to railway noise is lower than annoyance due to road traffic noise, while Japanese field studies reported similar or opposite results. To better understand differences and phenomena, an experiment had been conducted in laboratory conditions in Japan considering combined noise and vibration from a Shinkansen pass-by. The results highlighted significant effects of combined noise and vibration on activity disturbance (calculation and reading activities).

The current work aimed at repeating the same method in laboratory conditions in France. The experiment used a different apparatus. Twenty-nine European participants were submitted to the same nine combinations of noise and vibration levels of the Shinkansen pass-by. They were also asked to assess noisiness, the perception of vibration and activity disturbance during calculation and reading tasks. The results showed no significant differences between Japanese and European participants' ratings. This seems to indicate that differences between field studies might be due to distances from the tracks or to building structures. Significant interactions between noise or vibration levels and ratings, and tasks will be also presented and discussed.

34002 - A practical guidance to pooling and comparing annoyance scores and "high annoyance" (HA) responses on the 5-point and 11-point ICBEN scales

6. Community response to noise and noise annoyance
Keywords: Transportation noise, Highly annoyed, Exposure-response relationship, Meta analysis, Conversion rule
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The use of different annoyance scales across studies, in particular the popular 5-point and 11-points scales, has made the evaluation and comparison of noise annoyance among different studies a taxing issue, particularly for carrying out meta-analyses. More so, when "high annoyance (HA)" responses are compared and where the original surveys used different scales and hence different so-called cutoff-points for the definition of HA. This paper provides some guidance as regards the handling of different annoyance scales when aggregating annoyance response data from several surveys. The paper particularly discusses how to compare logistic exposure-response curves of the percentage highly annoyed (%HA), that involve different scales and hence, in most cases, different cutoff-points that define HA on the underlying scale (e.g. 72% or 60%). The necessary simulation of a cutoff point non-native to a scale can be achieved with a random resampling approach, which is exemplified using original data from recent noise annoyance surveys. Finally, the not insignificant limitations of mixing and/or comparing responses from different annoyance scales are discussed.

34003 - Impact of non-acoustical factors on road traffic noise annoyance and sleep disturbance in The Netherlands

6. Community response to noise and noise annoyance
Keywords: non-acoustical factors, road traffic noise, annoyance, sleep disturbance, impact
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Several studies have shown that next to acoustical factors also non-acoustical factors partly explain annoyance and sleep disturbance levels due to road traffic noise. There is still uncertainty, however, about the precise impact of these non-acoustical factors, especially for sleep disturbance. In this study we investigated the role of non-acoustical factors on annoyance and sleep disturbance responses due to road traffic noise in a large survey among 7956 participants in The Netherlands. A large set of non-acoustical factors was divided in four categories: demographic, situational, personal and contextual factors. In addition to calculating logistic regression associations, we investigated the impact of non-acoustical factors on annoyance and sleep disturbance by calculating population attributable fractions (PAFs), taking both risk and prevalence into account. Our study showed that various situational, personal and contextual factors are (highly) associated with noise annoyance and sleep disturbance. Expectations about future noise, trust in authorities, coping and sound isolation of the dwelling satisfaction showed high PAFs besides the actual noise levels at the façade. This indicates that these factors might be worthy to consider in future intervention strategies.

34012 - Does noise abatement through speed reductions reduce annoyance of a city population? Results from a longitudinal intervention study in Zurich

6. Community response to noise and noise annoyance
Keywords: Road traffic noise, Speed reduction, Health effects, Intervention study
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Many cities are reducing permissible traffic speed to enhance quality of life and as a means of noise mitigation, i.e. to disburden their population from road traffic noise above legal limits. The present intervention study explored the potentially health-beneficial effects of permanent speed reductions from 50 km/h to 30 km/h in the city of Zurich during a period of three years. We surveyed about 1300 randomly sampled inhabitants two times at least one year apart, before and after the regime changeover from 50 km/h to 30 km/h along 15 small- and mid-sized city streets. Concurrently, noise measurements in conjunction with traffic counts and speed measurements were carried out. The project focuses on the question of whether a hypothesized reduction in annoyance as a consequence of lowering the speed limit can be explained solely by the energetic level reduction achieved, or by other/additional factors as well, both acoustic (e.g. less steep slopes of passby-levels, lower maximum levels) and nonacoustic (e.g. improved sense of road safety). Data are currently analyzed, results will be presented at the congress.

7. Noise policy and economics

26264 - Developing noise policy by using scientific evidence on health effects of noise.

7. Noise policy and economics
Keywords: Policy, health, noise, Europe, solutions.
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Over the years, scientific evidence of health effects of noise increased, in terms of both number of studies and different health effects. In parallel, the noise policy has developed initially being based solely on the evidence that some health effects existed, until recently when the quantification of such effects has become part of the policy making. This quantification of effects allowed comparing policy options and justifying the costs of interventions to reduce noise, by showing that the health benefit exceeded such costs. Scientific literature has also been used by citizens to back their claims that noise damages health. And since citizens' claims ultimately might trigger policy decisions, science made it through to policy also this way. Finally, yet importantly, media can report about health issues. Here the situation is more scattered, and sees little interest of the media to the topic. As media are a third pathway conditioning citizens' choices and politicians' problem understanding, science should strive to communicate more effectively when it comes to noise and health effects, so as to attract media and therefore influence policy.

26601 - Science is not Enough: the Need for Noise Outreach, Advocacy, and Activism

7. Noise policy and economics
Keywords: policy, activism, outreach, advocacy
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Acoustic science and research about the harmful effects of noise have advanced dramatically since the US Environmental Protection Agency published information about noise levels requisite to protect public health and welfare in 1974. Despite specific evidence-based levels for noise affecting human health and function, noise levels in modern life continue to increase.

Clearly science and research by themselves are not sufficient to make the world quieter. They must be accompanied by outreach, advocacy, and activism.

Four examples of successful noise outreach, advocacy, and activism since 2014 will be presented: 1) convincing the US Centers for Disease Control and Prevention that noise causes hearing loss in the public, 2) stimulating reconsideration of a recommendation by the US Preventive Services Task Force for screening for hearing loss in adults, 3) obtaining a ruling against Amazon for falsely advertising that headphones using an 85 decibel volume limit are safe for children's hearing without time limit, and 4) convincing the International Telegraph Union that lower sound exposure levels are needed to protect children's hearing.

Many more unsuccessful efforts will also be presented.

26660 - Noise Exposure Causes Hearing Loss in Everyday Life

7. Noise policy and economics
Keywords: Noise induced hearing loss, tinnitus, ambient noise, transportation noise
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Noise-induced hearing loss (NIHL) is usuallyconsidered a problem only for workers with occupational noise exposure. Unfortunately, modern life is now noisy enough that everyday noise exposure can cause hearing loss. In the USA, NIHL affects 17% of teens and 24% of the adult population, most without significant occupational noise exposure**.** Noise can also cause tinnitus and hyperacusis.

The only evidence-based safe noise limit to prevent NIHL is an average daily exposure of 70 decibels (dB). In the USA, 50-70% of urban noise exposures exceed this level. The World Health Organization recommends only 1 hour at 85 A-weighted decibels (dBA) daily to prevent NIHL.

Common noise sources include public transit and transportation noise; ambient noise and amplified music at restaurants, bars, clubs, or celebrations like weddings; excessive sound levels in movie theaters, sports venues, and concerts; construction noise; and commercial or home appliances and power tools**.** Noise measurements will be presented.

Local, state, and national legislation is required to reduce noise exposure. Until such laws are passed and enforced, public education about the dangers of noise may help prevent NIHL.

28096 - The noise policies published by the League of Nations in June the 1937 are still in debt. Comparison between the actual policies and the earlier directions

7. Noise policy and economics
Keywords: noise policies, noise nuisance, history of science, architectural acoustics
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The directions given by the Committee on noise and housing (that belonged to the League of Nations) in June the 1937, which were written by the most important hygienists of those years, they are not well knew among the XXI acousticians. That reunion took place in Geneva and was the first of its kind, a few scientists and researchers written the international pioneer work for global noise policies many years before the WHO existence. This Paper compares those original noise policies with the last ones that were published, and the authors will try to establish the economic reasons on why after 83 years the noise nuisance and illness derived of high noise level are still going. Finally, the authors will show that all of those noise policies don't have changed through the decades.

28236 - The role of independent NGOs in U.S. noise research and regulation

7. Noise policy and economics
Keywords: noise, community response, policy, NGOs, strategy
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Since 1981, action on environmental noise has stalled. Federal laws (1972, 1978) are not being enforced, research on the health and public health effects of noise are scarce, and the will to regulate at state and local levels are discouraged by concerns over federal preemption. Consequently, the problem of noise pollution in the U.S. has grown dramatically, being labeled “the next big public health crisis,” and “the new secondhand smoke.” NGOs operating independent of government and industry have emerged to fill the vacuum, taking on: research, education/outreach, social network building, and advocating. One organization uses sociological change models and a spirit of constructive collaboration to inspire innovative research, technology solutions, and regulation. The authors describe six successful methods deployed across government agencies, professional associations, states, cities and towns that demonstrate how self-organizing, technology-enabled communities can achieve effective and lasting change even during a period of national political polarization.

28484 - An overview of national noise policies and environmental noise limits

7. Noise policy and economics
Keywords: noise policy, noise limits
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Noise is only to a limited extent mentioned specifically in national policy documents but can be considered included in concepts similar to "healthy environment" etc. Many countries have adopted recommendations to limit exposure to noise levels that may be associated with adverse health effects, but these recommendations are typically practical limits not necessarily linked to a general noise policy.

The paper will present an overview of national noise policies and environmental noise limits.

28586 - The aircraft noise pollution on the noise mapping and track map.

7. Noise policy and economics
Keywords: Okinawa Elementary school Futenma airbase Track map noise mapping
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Currently, about 70% of the area of US military bases nationwide is concentrated in Okinawa, which is about 10.4% of Okinawa's prefectural land area.Many US military bases are located in and around the city center and have many influences on urban planning.Above all, the problem of aircraft noise is serious and has a great influence on the living environment of the local residents, such as takeoff and landing sounds and engine adjustment sounds.In response to this, the country is taking measures such as soundproofing work, but it has not yet been solved.The purpose of this study is (1) to grasp and consider the actual situation by visual inspection of noise problems related to US military training, (2) to derive the wake of US military aircraft from the measurement results of precision sound level meter and visual inspection, and the measurement environment is appropriate from the results Consideration of whether or not, ③ Consideration of the noise damage situation for each point from the obtained noise mapping and track map.

28650 - U.S. Federal Aviation Administration Research on Aviation Noise: Understanding Challenges, Developing Solutions, and Informing Decision Making

7. Noise policy and economics
Keywords: Noise, Policy, Research, Outreach,Tools
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The U.S. Federal Aviation Administration is actively working to understand, manage, and reduce the environmental impacts of global aviation through research, technological innovation, policy, and outreach to benefit the public.

With the vision of removing the environmental constraints on aviation growth by achieving quiet, clean, and efficient air transportation; the FAA has assembled a comprehensive portfolio of research activities to guide investments in analytical tools, operational procedures, and aircraft technology; and informing decision making related to aviation noise.

This paper will provide an overview of FAA's aircraft noise research portfolio and the agency's broader goals to reduce the environmental impacts of aviation. Efforts in three key areas will be discussed:

1. **Effects of Aircraft Noise on Individuals and Communities**: Speech Interference and Children's Learning, Health and Human Impacts Research, Neighborhood Environmental Survey -- including a summary of the recently released technical findings on aircraft noise annoyance
2. **Noise Modeling, Noise Metrics and Environmental Data Visualization:** Aviation Environmental Design Tool, Noise Screening, Environmental Data Visualization, Supplemental Noise Metrics
3. **Reduction, Abatement and Mitigation of Aviation Noise**: Aircraft Source Noise Reduction, Noise Abatement, Noise Mitigation Research

28703 - New recommendations from WHO to limit annoyance from aircraft noise is not supported by existing evidence.

7. Noise policy and economics
Keywords: aircraft noise, annoyance, noise limits
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The World Health Organization recently published new recommendations for transportation noise to limit adverse health effects. The recommended safe limit for aircraft noise is about 10 dB below the limit currently being used in most European countries.

The new recommendations are based on a rather limited selection of post-2000 noise surveys. A closer look at the surveys reveals that a half of these have not been conducted according to standardized methods, but use questionnaires, selection of respondents, definitions of prevalence of annoyance, etc. that yields especially high annoyance scores.

A re-analysis of a larger and more representative selection of surveys, all of which have been conducted according to recommended standard procedures, shows that there has been no change in people's annoyance reactions. The results confirm the well-established exposure-response functions presented by Miedema and Vos I 1998, and they do not support WHO's decision to introduce more stringent limits.

28796 - Noise exposure ‘the new secondhand smoke’ - How is it addressed in building certification schemes

7. Noise policy and economics
Keywords: Regulations, Acoustics, Building certification schemes
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(introduction) Buildings that provide a pleasant indoor acoustic environment, allow employees to be more productive, students to learn easier and hospital patients to recover quicker. A survey concluded that 75% of office employees list noise as an important workplace feature, yet only 30% are satisfied with the noise levels in their office. A survey of the countries in the EU showed that 80% of respondents believed that noise affects their health, either to some or to a great extent. Additionally, noisy environments increase physical and mental risks for example hypertension, diabetes, and obesity. Building certification schemes have expanded to include the building's influence on the occupants.

(method) An analysis of the specific room acoustic requirements for open offices, which is the biggest building segment for green building schemes is the key component of the study. The analysis compares the quantitative requirements such as reverberation time and absorption area in 4 schemes (LEED, BREEAM, DGNB and WELL) to 8 national building regulations in Europe. As the building regulations only exist in their national languages these in depth comparisons are not common.

28936 - The environmental injustice of urban sound environments: a comparative analysis

7. Noise policy and economics
Keywords: environmental noise, restorative sound, socioeconomic status, noise management, health
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Sound has been researched as either an environmental pollutant with negative health effects or a restorative environmental resource with positive health benefits. However, the actual benefit or threat derived from an environmental resource differs between social groups. The environmental equity of sound as a resource remains understudied. A comparative analysis of 14 studies was performed, with a focus on the methodologies they used and the demographic and economic profiles of the cities they examined.

The results indicate that there is generally a distributive environmental injustice problem with noise pollution. In particular, noise exposure is higher, on average, for people from lower socioeconomic backgrounds. Moreover, methodological choices do not appear to predict the results obtained. This paper highlights the lack of research on the environmental (in)justice of restorative spaces; explores possible explanatory factors; provides theoretical contributions to the literature, calling for consistent and reproducible techniques to enable comparisons between results; and presents the remaining questions that still need to be investigated. As well, practical contributions are made to environmental noise management by applying an environmental justice framework.

28962 - Evaluating Health Effects of Noise from High Speed Two Phase 2a

7. Noise policy and economics
Keywords: railway, sleep disturbance, annoyance, hypertension, ischemic heart disease
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The UK Government has created HS2 Ltd to develop a high-speed railway that provides capacity and connectivity to populated urban areas. Phase 2a of the railway connects Birmingham to Crewe and was subject to an Environmental Statement (ES) in 2017. The ES methodology for Phase 2a was developed in accordance with the amended EIA Directive 2014 (2014/52/EU) that requires that EIA should 'identify, describe and assess' the effects of a project on 'population and human health'.

A receptor-level assessment of noise from the new railway was included within community area reports. This presented significant effects following Government noise policy and evaluation criteria first chosen for Phase One of HS2. To address the amended requirements of the EIA Directive, a population-level assessment of the effects of railway noise was undertaken using the UK Government Transport Analysis guidance (WebTAG). This guidance evaluates health effects arising from change in noise exposure, comprised of several components including sleep disturbance, annoyance, hypertension and ischemic heart disease. This paper will present the evaluation, outcomes and presentation of health effects of noise for Phase 2a of HS2.

28963 - Environmental noise in Europe – a status update from the latest data submitted under the Environmental Noise Directive (END)

7. Noise policy and economics
Keywords: Europe, Strategic noise mapping, Health impacts, Environmental noise Directive, Noise policy
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The third phase of noise mapping and action planning in Europe in accordance with the Environmental Noise Directive (END), is now complete and data has been compiled and analysed by the European Environment Agency. This paper presents an assessment of the population exposed to high levels of environmental noise and the associated health impacts in Europe based on the latest data collected under the END. Overall, the END 2017 covers all road, rail, air and industrial noise sources for 511 urban areas across the European territory, 420 791km of major roads, 49 729km of major railways and 89 major airports. The paper also documents actions being taken to manage and reduce noise exposure, and reviews the progress made towards meeting the obligations established in the END and the 2020 noise objectives outlined in the Seventh Environment Action Programme (7th EAP). A review of the outcomes as well as current challenges and future improvements are identified and discussed.

29006 - Noise and health in the Dutch practice with the environmental noise guidelines for the European Region of the World Health Organization.

7. Noise policy and economics
Keywords: Environmental noise guidelines, Noise policy, noise regulations, burden of disease, noise and health
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In October 2018, the Regional Office for Europe of the World Health Organization (WHO) published their environmental noise guidelines. In this document, WHO presents noise guideline values and recommendations for five different noise sources. The aim is to protect the health of the population against the negative impacts of environmental noise. The WHO noise guidelines are intended to support policymakers and other (local) professionals in creating rules, policy and advice in the area of noise and health. In response to the publication of the WHO advice, a motion was filed in Dutch parliament. As a consequence, RIVM was commissioned to start a study with the aim (i) to provide interpretation of the WHO advice in comparison to the current Dutch regulations for environmental noise, and (ii) to investigate how the WHO advice can be used to strenghten Dutch noise policy. The results of our study will be presented during the conference.

29016 - Review of environmental noise policies and actions in 2017-2020

7. Noise policy and economics
Keywords: International organizations; National policies; Noise management; Developing countries
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This report provides an update of the review of environmental noise policies and economics in 2014-2016, published in the proceedings for the ICBEN 2017 Congress. The report addresses the international progress on noise mitigation policies and strategies, best practices and guidelines for environmental noise management. It focuses on developments in evidence and policy by international bodies and in selected countries. There is a considerable amount of new relevant documents in many countries on these topics since the last ICBEN Congress in 2017. Much of this progress was made in the European Union, the United Kingdom and Switzerland. Developing countries and countries in transition, especially Chile, Costa Rica, India, Mexico, Indonesia, and Paraquay are increasingly committed to improve environmental noise policies. The evolving economical assessments of noise exposures are particularly important because they reflect the limits of the ‘polluter’s pay principle’ and are crucial for governments to implement adequate and affordable noise mitigation policies.

29081 - Understanding Equity, Diversity and Inclusion in Noise Pollution Research Through a Community-Led Lens

7. Noise policy and economics
Keywords: community, equity, inclusion, noise, collaborations
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A team of Community Researchers in collaboration with the Cornell Lab of Ornithology share a different perspective and approach for doing science "*with"* communities. The Noise Pollution Project (noiseproject.org), funded by the National Science Foundation (#DRL-1811234), aims to document the co-creation of an international community science project guided by our framework and non-negotiables for engaging in equitable research in communities historically excluded from the sciences. We focus on Trust and Transparency and recognize the role of Power and Privilege in science.

Through Community Science Collaborators, each of our communities uniquely defines the way we implement the noise pollution project and carry out our research, based on our strengths and needs. We own the project and apply results towards education, social justice, policy, and wellness goals.

Through humor, honesty, using the arts, and storytelling, the authors, leaders from underserved communities, will share our community-based participatory research results in a presentation focused on equity in noise pollution and our perspectives about collaborations between science institutions and community-based organizations that could potentially change the sciences by advancing justice, equity, diversity and inclusion.

34030 - Awareness research on noise pollution in Okinawa Prefecture

7. Noise policy and economics
Keywords: Okinawa, aircraft, US military, air pollution, noise
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In Okinawa Prefecture, the noise caused by aircraft at US military bases has been taken up as a social problem. Therefore, the purpose of this study is to investigate the position of students living in Okinawa prefecture on pollution based on a questionnaire survey. The eight items that make up environmental problems are air pollution, water pollution, soil pollution, noise, ground subsidence, foul odors, radioactivity, and global warming gas. We conducted a research study on how noise is perceived as pollution.

In Okinawa Prefecture, the majority of students regard noise as one of the pollution problems, "it is not as important as pollution, but it is a familiar problem."It is possible that there is a tendency to think that noise is less dangerous to life, and that the importance of noise from aircraft at US military bases has become less popular.

8. Noise exposure assessment in health effect studies

28478 - The use of wearable devices to capture noise levels in population health studies

8. Noise exposure assessment in health effect studies
Keywords: exposure assessment, health effects, epidemiology
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Wearable devices offer novel approaches to collect environmental data at the individual level and are becoming widespread in use, both commercially and in academics. Wearables may be particularly valuable in assessing exposures that cannot be captured by bioassays, such as environmental noise. Recently, Apple unveiled a new noise sensor and corresponding application in their watches that is able to detect noise (in decibels) with little additional input from the user. Use of these devices in epidemiologic studies could drastically improve our understanding of the health effects of noise, while also collecting important individual-level health data. However, the accuracy of these devices, as compared to gold standard instruments, remains largely unknown. Here, we compare the performance of wearable and commercially off the shelf noise measurement devices to gold standard noise meters. Then, we pilot the use of these wearable devices in a group of women enrolled in a birth cohort in New York City. Ultimately, the completion of our aims will show the utility of using wearable devices to collect individual-level environmental noise exposure data in large scale epidemiologic studies.

28555 - Fundamentals of road traffic noise surveys, and where they often fail.

8. Noise exposure assessment in health effect studies
Keywords: noise, annoyance, survey, policy, response
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For exposure-response studies to successfully inform government noise control policy they must be both linked to, and sensitive to the long-term transport planning strategies. Failure of studies to meet this fundamental objective has been highlighted in the meta-analysis of annoyance responses for road traffic noise that underpin the 2018 *World Health Organisation Noise Guidelines for the European Region*. Despite the individual studies being subjected to a rigorous qualification process, there was significant variation across studies at the same day-evening-night noise level. This indicates that use of a generalised noise exposure indicator alone is not a satisfactory measure of community annoyance, and there is a need to recognise that traffic flow profiles and site characteristics which are influenced by transport and planning policy, are significant confounding factors. In this work, the adequacy of fundamental information collected for such studies is evaluated. The minimum amounts of site and traffic flow information required to produce robust and comparable socio-acoustic surveys are proposed. Additionally, the need for supplementary indicators to enhance the understanding of variations in annoyance at a given noise level is discussed.

28823 - Quantification of noise exposure from wind turbines in France

8. Noise exposure assessment in health effect studies
Keywords: wind turbine noise, quantification, exposure, France
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The WHO guidelines on environmental noise highlight that evidence on the health effects of wind turbine noise is either non-existent or of poor quality. In this context, a feasibility study was conducted in France. The objective was to suggest a methodology for calculating wind turbine noise in order to quantify the number of windfarms' residents exposed to different levels of this noise. Based on a literature review, the Harmonoise model was selected for noise exposure calculation. The contribution of a wind farm varies from 35 dB(A) to 45 dB(A) for distances from 500m to 1500m, depending on weather conditions. Compared to other environmental noise sources (e.g. transportation), the noise exposure is very moderate and the total number of exposed people is very low: about 258,000 people during the day and 353,000 people at night, i.e. about 0.4% and 0.5% of the French population in 2017. Nearly 85% of the exposed population is exposed to levels below 40 dB(A). These results are the first ever assessment of noise exposure from wind turbines on the scale of the entire metropolitan French territory.

28894 - Study of human health risk and its evolution in urban areas

8. Noise exposure assessment in health effect studies
Keywords: noise exposure, noise dose, noise risk assessment, noise calculation, noise zones
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The urban population is constantly exposed to acute and chronic noise that leads to health disorders. It is hardly possible to eliminate these impacts in a short time. The questions still remain regarding exposure duration without changing to another risk category, risk evolution, and types of health disorders.

The study aims to assess the given risk and its evolution using acoustic modeling data taking into account an urban transport system. As a research object a large Russian city with heavy traffic was taken. Research methods are as follows: traffic flow monitoring, acoustic calculations, simulating noise situations, both current status and perspective, using GIS. The risk evolution of negative effects is described with a system of differential equations representing the accumulation of functional disorders associated with noise exposure in contrast to natural biological processes in the body.

The scenarios of possible public health disorders under the existing traffic scheme were considered as well as perspective scenarios with the city transport infrastructure development providing acceptable health risk. The study offers the characteristics of living areas according to the risk criteria.

28977 - Integrating random forests and the SoundPLAN propagation model for high-resolution noise mapping: a case study in Montreal

8. Noise exposure assessment in health effect studies
Keywords: noise levels; SoundPLAN; random forests; three-dimension propagation model, Montreal
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The adverse effects of long-term exposure to noise on human health are increasingly concerned. Traditional noise mapping methods such as spatial interpolation and land use regression cannot capture complex relationships between environmental conditions and noise transmission or dissipation in a three-dimension (3D) space. In this study, we developed a hybrid approach by combining the SoundPLAN propagation model and random forests (RF) machine learning algorithm to map daily average, daytime, nighttime, and day-evening-nighttime noise levels at the 30*m* resolution. SoundPLAN was used to simulate basic noise surfaces using traffic flow and 3D building data. The SoundPLAN-estimated noise levels were compared with *in situ* measurements at 87 points, and residuals were further interpolated by the RF model and multiple environmental/geographical variables (e.g., vegetation index, population density, land use types, and distances to NEF25 contour, and bus stops). The leave one out cross-validation showed that the mean error, absolute mean error, and root mean squared error of daily average noise levels estimated by our hybrid approach was -0.03*dB(A)*, 6.42*dB(A)*, and 8.14*dB(A)*, which are smaller than those estimated by SoundPLAN model singly.

28982 - The Apple Hearing Study: a novel approach to assessing music and noise exposures and associated health impacts

8. Noise exposure assessment in health effect studies
Keywords: Noise exposure, music exposure, hearing loss, cardiovascular impacts, crowdsourced data collection
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Although noise and music exposures are extensive and widespread, there is a paucity of objective, large-scale data available regarding personal music and noise exposure levels and patterns, as well as the health impacts of these exposures. The University of Michigan School of Public Health has partnered with Apple, Inc. to use advances in smart device and wearable technology to evaluate the levels of sound at which iPhone users listen to music and other media, as well as how long and how often they listen. Our study will also evaluate hearing threshold levels among participants, and, among the subset of participants who wear Apple Watches, will measure environmental noise levels and collect heart rate information, as well. The unique crowdsourced dataset resulting from this study will allow us to create national-level estimates of adult exposures to music and environmental sound. The information collected will also help give us a clearer picture of the impacts of music and noise exposures on hearing and cardiovascular health in adults, and ultimately inform efforts to address and reduce the public health impacts of these exposures.

33888 - Method for measuring space-time-activity-exposure patterns of children

8. Noise exposure assessment in health effect studies
Keywords: children, noise exposure, space-time-activity pattern
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When measuring the effects of noise on health, we often take the noise level at home as a reference value for the exposure response functions. However, how valid is this assumption? Looking specifically at children, exposure to noise not only varies throughout the day, but also depends on space-time-activity pattern. With an increasing age, children's activity space quickly changes and enlarges due to the exploration of new environments . During the day, different locations are used for a variety of activities. The susceptibility to noise exposure is influenced by the type of activities performed. Finally, the activity may be influenced by social circumstances like role expectations. In other words, the noise level at home may not be sufficient to capture the whole picture. In this study our goal is to describe noise exposure through actual used spaces and explore the social influences on children's space-time-activity-exposure patterns to shed light on the root of health inequalities. This paper presents a method for measuring space-time-activity-exposure patterns for children aged 0-21 years old using GPS tracking, activity diaries and a combination of noise measurements.

33999 - Mental stress due to noise in retail trade

8. Noise exposure assessment in health effect studies
Keywords: noise, retail trade, measurements, questionnaire, field study
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Employees in retail trade are exposed to acoustic environments with a variety of sound sources every day and are therefore affected by non-auditory health effects of noise. Hence, a study was conducted in which twelve shops of the textile and four shops of the food retail trade participated to investigate the exposure of their employees. Personal exposure meters and stationary sound level measurements were used to quantify the noise levels. For psychological evaluation of working-condition-perception, a validated questionnaire, which also included questions on noise sensitivity, was used. A distinction was made between mental stress and strain.

No correlation could be observed between sound pressure level-based parameters and questionnaire results. The questionnaire turned out to be a more effective method to evince the exposure to mental stress of employees than the sound level measurements. Even though, noise sensitivity of the participants had an impact on the mental strain, it did not affect the recognition of mental stress. Further studies should focus on the investigation of suitable acoustic parameters for describing auditory induced mental load.

34011 - Predicting traffic noise – a scalable approach using land-use regression

8. Noise exposure assessment in health effect studies
Keywords: noise mapping, land use regression, modelling, exposure assessment
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Notable noise mapping obligations exist in the European Union. However, they are limited to designated areas such as large agglomerations and main traffic infrastructures and therefore exclude certain populations from exposure assessments and consecutive noise action planning. Existing maps are not spatially congruent to epidemiological cohorts like the German National Cohort (NAKO). As noise mapping is frequently confined by the necessary resources and data, we searched for economic alternatives for area-wide noise mapping making use of spaceborne earth observations. Using remote sensing methods, we built a geostatistical model embracing the arrangement of sources of noise and the surrounding environment in which the sound propagates. In our experimental set-up, we relied on publicly available noise data, context-aware feature engineering and a machine learning model. Eventually, the scalable approach explained 78% of the variations and can be deployed for predictions at a high spatial granularity of 10x10 meters. With it, we aim to spatially close the blank spots in existing noise maps allowing to assess noise exposure beyond already mapped urban populations in suburban and rural areas as well.

9. Special topics related to noise effects

26551 - A New Definition of Noise: Noise is Unwanted and/or Harmful Sound

9. Special topics related to noise effects
Keywords: noise, definition of noise, noise policy, health effects of noise
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The words *sound* and *noise* are used interchangeably in acoustics, electronics, and physics, but have different connotations when applied to listeners. *Sound* is defined as vibrations traveling through air or another medium that can be heard when they reach a person's or animal's ears. *Noise* is commonly defined as *unwanted sound* or *undesired sound*. In engineering, *noise* has the additional connotation of signals that have no meaning and vary over time, usually randomly.

Unfortunately, the phrase *unwanted sound* implies a value judgment about the listener, with a subjective component to the listener's judgment or complaint. Often, there is the additional implication that those who complain about noise are neurotic, weak, self-centered, or have some other personal problem that for them magnifies the impact of sounds that don't bother others.

This latter implication is incorrect. Desired sounds can cause auditory damage. Unwanted sound is stressful and has proven adverse auditory and non-auditory effects. Evidence-based levels for noise affecting human health and function are well known. That is why I propose a new definition of noise: *Noise is unwanted and/or harmful sound.*

28317 - A review of aggravating factors of the occupational noise-induced health effects

9. Special topics related to noise effects
Keywords: Noise Effects, Combined Effects, Combined Exposure, Occupational Exposure, Aggravating Factors
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Abstract

Noise-induced health effects are exacerbated by many other risk factors. This study aimed to systematically review the epidemiological literature of the aggravating risk factors of the health effects due to occupational noise exposure. PRISMA and MOOSE guidelines were followed. PubMed, Science Direct, and Google Scholar were searched up until 15 December 2019 in English, and Persian with appropriate keywords on combined effects of occupational noise, and co-exposure to noise and other factors. A total of we found 150 articles that were relevant and had sufficient quality for analysis. Overall, 15 risk factors were identified include at the four groups; chemical (solvents, heavy metals, and other chemicals), physical (lighting, heat, vibration, and cold), personal (age, gender, genetics, smoking, medication, contextual diseases) and occupational (workload, and shift work). Hearing loss, hypertension, reduced performance, and cardiovascular strains, are the most important the combined effects due to concurrent exposure to noise and other risk factors. Therefore, in the Hearing Conservation Programs, besides noise, aggravating factors of noise effects should also be taken into account.

28501 - Raising awareness among nursing staff about soundscape quality in care environments

9. Special topics related to noise effects
Keywords: Long term care, dementia, soundscape, quality of life, professionalization
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It is commonly known that vulnerable people are sensitive to the "mood" of their environment. We therefore investigated raising awareness of the role of sounds and soundscape among care-givers for people with dementia.

In the MoSART+ project we educated 3 or 4 care professionals about the role of sounds in 4 nursing homes. These "ambassadors" then implemented a three-step intervention. In Step 1, daily care-givers rated the quality of the sonic environment at random moments during two weeks with the MoSART-app. Step 2 involved a brainstorm on care/soundscape that resulted in a set of improvements to be implemented before step 3. In Step 3, care-givers rated the sonic environment again for two weeks.

The standard soundscape taxonomy is easily understood and illuminating for care-givers. In all cases we observed an improvement in the soundscape quality in terms of less chaotic or boring moments and more lively and calm moments. In addition care-givers reported that they had learned valuable things about the role of sounds in long-term care that improved their professionalism and gave them more control over the care-process.

28615 - Development of a new ISO Technical Specification on non-acoustic factors to improve the interpretation of annoyance and soundscape datasets

9. Special topics related to noise effects
Keywords: non-acoustic factors, annoyance, soundscapes, ISO TS 15666, ISO 12913
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There are currently four international standards relating directly to the human perception/evaluation of sound: ISO TS 15666 (assessment of noise annoyance) and ISO 12913 parts 1,2 and 3 (measurement and assessment of soundscape quality). These standards aim to harmonise the characterisation of perceptions/reactions to a specific sound/sound environment. Personal, social and situational variables (often referred to as non-acoustic factors) are as important as acoustic features in determining human evaluation of sound. Currently socio-acoustic surveys on annoyance/soundscapes attempt to quantify the influence of these non-acoustic factors using study-specific questions. This limits opportunities to merge different survey datasets in order to a) evaluate the effectiveness of specific questions as measuring instruments b) improve the interpretation of survey data and c) identify effective non-acoustic interventions. This paper describes the initial stages in the development of a new ISO Technical Specification that aims to standardise the characterisation of non-acoustic factors in socio-acoustic surveys. A list of relevant non-acoustic factors is compiled and categorised based on relevance and the availability of standardised questions. Several different approaches for formulating an ISO Technical Specification are then discussed.

28893 - Mapping of transportation noise-induced health risks as an alternative tool for risk communication with local residents

9. Special topics related to noise effects
Keywords: Noise map, health risk map, sleep disturbance, ischemic heart disease, risk communication
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Environmental noise, predominantly regarded as a public health problem, remain little-known to the public. Translating the conventional methods of sound level and sound map used in environmental noise assessment into a language that the public can understand is a challenge. Therefore, to improve public understanding of the potential health threats, an effective risk communication strategy is required. Visualising the risks using health risk maps may convey a clear message, thus gaining attention from the public. In this study, we made noise maps in Sapporo City, Japan. Then, the exposure-response functions established by WHO Regional Office for Europe were applied to convert the noise maps to health risk maps. Key health outcomes in the guideline, namely high annoyance, high sleep disturbance, and ischemic heart disease, were selected as the health indicators. The risk maps visually represent the distribution of significant risks of noise. This approach would be very useful in communicating the risks in a manner which is easily interpreted by the local community.

28895 - Using simulations to quantify the effect of correlated exposures in a study of the association between road traffic noise, air pollution and a cardio vascular outcome

9. Special topics related to noise effects
Keywords: noise,air pollution, cardio-vascular disease, correlation, simulation
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Air pollution is a known risk factor for cardiovascular morbidity, and traffic noise is a suspected risk factor. Road traffic is a mutual source, so their respective effects are difficult to disentangle. To quantify the effect of including correlated exposures in a regression model, a small simulation study was performed.

For the Swedish Primary Prevention Study cohort (men born 1915-1925), data were available, both annual modelled exposure data (NOx and noise) and cardio vascular morbidity data (through linkage to the Swedish patient registry). A bivariate exposure model was constructed, where trends and marginal stochastic variation mimicked the observed NOx and noise data. This model allowed us to computer-generate exposure data, with different degree of spatial correlation as well as correlation over time. Next, the morbidity outcome was computer-generated as a function of both exposures.

Preliminary results, based on 100 repetitions of each correlation scenario, showed that in a one-pollutant model, a high spatial correlation often leads to an overestimation of the risk, whereas a strong correlation over time can lead to more narrow confidence intervals for the hazard ratios.

28902 - Noise sensitivity in mild traumatic brain injury

9. Special topics related to noise effects
Keywords: noise sensitivity, mild traumatic brain injury, post-concussion syndrome, anxiety, depression
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Mild Traumatic brain injury (mTBI) is defined as TBI with loss of consciousness for 30 minutes-or-less, coinciding with a disoriented state lasting for less than 24 hours. The perseverance of mTBI-related symptoms is termed as post-concussion syndrome (PCS). One of the commonly listed symptoms of PCS is noise sensitivity (NS). The aim of this study was to describe the persistence of NS in mTBI across a 12-month period, to examine the relationship between NS and selected clinical correlates, specifically anxiety and depression, and to determine if NS at an early stage of recovery has a predictive value for later PCS. The 341 participants (201 males, 140 females), age range from 16 to 91 years, were taken from a pre-existing dataset generated as part of the BIONIC project, a New Zealand population-based TBI incidence and outcome study. We found that reports of NS declined across 12 months. Anxiety predicted NS in the early stages, depression in the later stages, and somatic post-concussive symptoms across all time points. In turn, NS showed itself as a significant predictor of future post-concussive symptoms.

28944 - Thermal sensation effects evaluated during road traffic, construction site, and railway noise

9. Special topics related to noise effects
Keywords: thermal sensation, noise evaluation, road traffic noise, construction site noise, railway noise
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This study examined the relation between noise evaluation and thermal sensation. In an experimental room, 324 students evaluated noises from summer through autumn. They evaluated loudness and impressions of road traffic noise, two railway noises, and three construction site noises, each given for 10 s at three levels of 72 dB, 65 dB, and 58 dB. Participants then recorded their evaluations for 45 s. For each participant, the noise order was set randomly using Latin grid method. Participants also responded to thermal sensations in the experimental room using a seven-point scale. Results show a relation between noise evaluation and thermal sensation. Relations differed by the kind of noise, and with hotter thermal sensations. Road traffic noise was evaluated as louder; construction site noise was evaluated as less loud. Railway noise was evaluated as least loud at points near thermally neutral. These tendencies were more distinct for high sound levels.

28997 - Visualisation of traffic noise exposure and health impact in a 3D urban environment

9. Special topics related to noise effects
Keywords: Traffic noise, visualization
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It is becoming increasingly common to work with urban planning using 3D visualisation tools. In the project DemoVirPEN a research team with participation from different research fields cooperated to create a demonstration concept for visualising traffic noise and the associated health impact in a 3D graphics environment. The project included participation from the following fields; 3D modelling and mapping, traffic noise calculation, auralisation, urban planning and architecture and health impact of noise exposure. The final product of the project is summarised in a film clip that illustrates the main results by visualising and auralising traffic in different configurations from different perspectives. A few key points are visualising short time frames (single vehicle passage) versus yearly average (noise map), and impact of changes such as removing or modifying traffic flows and buildings.

29026 - Does noise modulate the impact of air pollution on pregnancy: an approach of fetal growth and moderate levels of exposure.

9. Special topics related to noise effects

Keywords: Fetal Growth Restriction, Small for Gestational Age, noise, air pollution, PM10

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The objective was to analyze the potential modulation of noise on the relationship between fetal growth restriction (FGR) or small for gestational age (SGA) and environmental exposure to moderate levels of air pollution. Nearly 9000 women living in the city of Besançon or Dijon (France) and who delivered between 2005 and 2009 were included. FGR and SGA were obtained from medical records. Average daily noise levels were defined in front of the entire façade of the building ($L_{Aeq,24h}$) and exposure to nitrogen dioxide (NO_2) and particulate matter (PM_{10}) was considered with a 50m radius buffer over the home address for different periods of pregnancy. A total of 587 FGR and 918 SGA were identified. For SGA and FGR, adjusted OR associated with a 5-dB-increase of $L_{Aeq,24h}$ ranged between 0.95 and 1.00. Adjusted OR associated with a 10-$\mu g/m^{3-}$ increase of PM_{10} during the last two months before delivery was 1.18 (SGA) and 1.36 (FGR). Adjustment on noise exposure led to the same results. These results are in favor of an absence of effect of noise on fetal growth.

29041 - Investigation on VHF sounds in the ears project Japan - part1

9. Special topics related to noise effects
Keywords: very high frequency sound, children's hearing threshold, measurement of VHF
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We have reported the recent activities for research on very-high-frequency (VHF) sound in Japan. In this paper (part-1), we introduce the background, summary of our investigation and the result of subjective hearing threshold in such VHF region.
The issues on high pressure of VHF sounds including ultra sounds in air that cause various subjective effects have become important around all world.
Similar problems on VHF sounds, for example, noise annoyance by VHF sounds radiated from rodent repelling devices, were emerging also since about 10 years ago in Japan.
The ears project Japan which have been established against such issues in recent years decided to conduct VHF research, measurement and evaluation in Japan.
We introduce summary of the ears project Japan and measured results of subjective threshold in VHF region positioned as part of most important research issue.

34020 - Towards a method for subjectively evaluating the impact of facade insulation by acoustic virtual reality

9. Special topics related to noise effects
Keywords: noise annoyance, acoustic virtual reality, environmental noise
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In order to support acoustic consultants in providing tailored solutions to clients regarding facade insulation against environmental noise, a subjective method has been designed to assess the effect of four types of façade solutions by using acoustic virtual reality. In this exploratory study, environmental traffic noise was recorded in first-order ambisonics inside an apartment in which facade is exposed to road traffic noise, and simultaneously a 360-degree picture was captured. For a listening experiment, the measured indoor audio stimuli were filtered according to spectral changes corresponding to four acoustic facade intervention scenarios. To test the effect of environmental noise on noise annoyance and performance, a within-subject experiment with n=10 participants was designed containing ISO/TS 15666 questions and a Rey auditory verbal learning task (ReyT). Both tasks were carried out in a VR environment, which consisted of a head-mounted display and headphones. The subjective results showed a statistically significant linear effect between the amount of noise and the annoyance. However, the objective results were inconclusive. This paper gives insight in the method to experience acoustic facade interventions prior to construction.

10. Low frequency noise and vibration

27497 - Defining a single descriptor to assess the LFN using the dBC-dBA only on low-frequency bandwidth to avoid the uncertainty of applying it by the whole frequency bandwidth

10. Low frequency noise and vibration
Keywords: Low-frequency, noise, assessment, legislation, Standard
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For more than 80 years of using the dBA the discussion is still going about its LFN underestimation, it is well known among acousticians that the dBA was defined in 1936 just to measure low levels signals up to 60 dB. Since 1969 when Botsford introduced the idea of the dBC-dBA values could indicate the amount energy in low-frequency range, several researcher have been introduced some rating curves or some descriptor to assess the low-frequency noise contained in a sound spectrum. WHO recommends the use of dBC-dBA and it suggests when that difference is greater than 10 dB an analysis should be applied, but it doesn't say anything about what frequencies we have to use for it. In this Paper the authors are proposing to use one single standardized descriptor based on ISO 1996 low-frequency band definition, in the sense of using the difference between dBC and dBA from 16 Hz to 200 Hz, because it is more accurate to apply this criteria on those frequency instead of the whole bandwidth since they include energy in middle and high frequencies.

28601 - Influence of test sound on hearing threshold by up-down method

10. Low frequency noise and vibration
Keywords: Hearing threshold, Up-down method, Continuous/Intemittent test sound, 1/3 octave band
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At a previous meeting of ICBEN, we presented the influence on a hearing threshold with up-down method by various test sounds using 63, 31.5 and 16Hz as 1/1 octave band central frequencies. The test sound form - continuous/intermittent and the level change rate gave larger influences on hearing threshold than the other condition. The small level change rate had the effect of reducing the threshold levels and the standard deviations. The intermittent sound form reduced threshold level at 63Hz than continuous form. So, we narrowed down the condition to the test sound form and conducted the experiment again using 1/3 octave band central frequencies from 10 to 100Hz with 19 subjects. Above 20Hz, hearing threshold of intermittent forms tended to be lower than continuous forms. On the other hand, a slightly opposite tend was observed below 20Hz. The difference between the hearing thresholds was less than 2dB.

28608 - Subjective listening experiment for low frequency psychoacoustic noise reduction

10. Low frequency noise and vibration
Keywords: “Missing fundamental” effect, Bass frequency doubled shift, Subjective listening
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Noise disturbance of low frequency from the sound enhancement system is difficult to be insulated. The bass noise costs much to insulate by heavy floors and partitions. In this paper, a new signal processing mode named “bass frequency doubled shift”, the BFDS, on the base of the psychoacoustic “missing fundamental” effect is brought up. Subjective listening experiment shows that, the auditory differences between the original songs and the BFDS songs are “little”. This signal processing mode is a new idea for bass noise abatement.

28838 - Occupational exposure to whole body vibrations and birth outcomes – a nationwide cohort study of Swedish women

10. Low frequency noise and vibration
Keywords: Occupational exposure, whole body vibrations, pregnancy, birth, preterm
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Introduction: It is unknown whether the current exposure guidelines for whole body vibrations (WBV) are appropriate during pregnancy. Therefore, the aim of this study was to assess whether occupational WBV-exposure increases the risk of preterm birth (PTB), low birth weight, and/or small-for-gestational age, in a nationwide, prospective, cohort.

Design: The Fetal Air Pollution Exposure cohort (FAIR) was formed by merging national registers, and the present study included singletons born to working women in Sweden between 1994-2014 (n=1,090,988). Exposure to WBV was assessed using a job-exposure matrix, and odds ratios were calculated and adjusted for potential confounders, including other occupational exposures.

Results: Exposure to WBV, among full-time working women with low absence from work during pregnancy (n=349,001), was associated with an increased risk of PTB. Compared to unexposed mothers, the OR was 1.41 (95% CI: 1.06, 1.87) for exposure ≥0.5 m/s^2 (current action limit value), and 1.35 (95% CI: 1.00, 1.82) for exposure between 0.3-0.4 m/s^2.

Conclusions: WBV-exposure was associated with an increased risk of PTB. The current exposure guidelines do not seem to adequately protect pregnant women with continuous exposure.

35966 - Low frequency noise Overview Talk

10. Low frequency noise and vibration
Keywords: Low frequency noise, Overview Talk
Norm Broner

Low-frequency noise (LFN) generally refers to those components of noise below 100 Hz and generally is considered to include infrasound, ie those components of noise with frequencies below 20 Hz. Infrasound (IS) in some industrial circumstances can be a legitimate source of annoyance. In the last number of years, a majority of the papers relating to LFN have been about the impact of Wind Turbines (WT's) and in particular, about the apparent impact of IS. There is a lot of misinformation about the noise impact of WT's available via the internet and a lot of misinformation about the role played by IS. Recently, the focus on WT noise effects has somewhat turned from blaming Infrasound for any claimed effects to a consideration of the impact of amplitude modulation. In addition, there is a recognition that, as for many noise sources, engagement with potentially affected neighbours of proposed new wind farms is an important step in mitigating response. This paper will review recent papers and will describe recent developments.

11. Health impact assessment/Burden of Disease

28507 - Health benefits associated with speed limit reduction: a health impact assessment of noise and road traffic injuries for the Swiss city of Lausanne

11. Health impact assessment/Burden of Disease
Keywords: health impact assessment, 30 km/h speed limits, diabetes, cardiovascular diseases, sleep disturbance
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Reductions of speed limits for road traffic are effective in reducing casualties, but are also promoted as an effective way to reduce noise exposure. We estimated noise related health benefits of the implementation of 30 km/h speed limits in the city of Lausanne (135'000 inhabitants). The study followed a standard methodology for quantitative health impact assessments to derive the number of attributable cases. We compared a reference scenario (without any 30 km/h speed limits) to the current situation with partial speed limits and additional scenarios with further implementation of 30 km/h speed limits, including a whole city scenario. Noise reduction owned to the current speed limit situation is estimated to annually prevent 1 cardiovascular death, 72 hospital admissions from cardiovascular disease, 17 incident diabetes cases, 1'127 individuals being highly annoyed and 918 individuals reporting sleep disturbances from noise. A whole city speed reduction scenario would more than double these health benefits. This study indicates that health benefits from noise reduction is even more pronounced than safety benefits related to the implementation of 30 km/h speed limits in an urban environment.

28614 - Health impacts related to noise in two major Estonian cities

11. Health impact assessment/Burden of Disease
Keywords: health impact assessment, transportation noise, road traffic noise, railway noise, aircraft noise
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Taransportation noise is a growing environmental concern in cities worldwide due to annoyance, sleep disturbance and burden of cardiovascular diseases. Recently, European Commission has been developing a common methodology for assessing health impacts of ambient noise in EU. Using this methodology, we quantified the health effects of road, railway and aircraft noise in Tallinn and Tartu. It appeared, that the proportion of highly annoyed residents due to road traffic noise is expected to be 11.7% in Tallinn and 9.2% in Tartu and around 2.4% of residents are having sleep disturbance. The incidence of ischaemic heart disease (IHD) induced by road traffic noise is estimated to be 122.6 cases in Tallinn and 21.5 cases in Tartu. Altogether noise is estimated to cause 1807 disability adjusted life years (DALY) in Tallinn and 370 DALY in Tartu. The external cost of ill-health is estimated to be 126.5 and 25.9 million € annually, respectively. Railway and aircraft noise health effects are small in both cities. Lowering the exposure level 5 dB leads to 67.7 % higher estimate of transportation noise burden in Tallinn.

28973 - Traffic noise impacts on disability-adjusted life years due to ischemic heart disease, annoyance and sleep disturbance in Toronto, Canada

11. Health impact assessment/Burden of Disease
Keywords: DALY; traffic noise; burden of disease; heath impact assessment; Canada;
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This paper estimates the burden of disease (BoD) from ischemic heart disease (IHD), annoyance, and sleep disturbance attributable to traffic noise in Toronto, Ontario, Canada. Previous research showed that 7% of all Canadians and up to 36% of residents in central areas of Toronto are highly annoyed by traffic noise. Furthermore, a recent epidemiological study showed a link between traffic noise and IHD among other chronic health outcomes in Toronto. A comprehensive environmental noise monitoring and modelling exercise to estimate population exposures was completed in 2016. This included predicted facade traffic noise levels from a propagation model based on the US FHWA Traffic Noise Model (TNM2.5) that were applied in this study. The model showed excessive population exposures to traffic noise, with 92% of the population exposed to Lden façade levels exceeding 53 dB, and 72% exposed to Lnight levels exceeding 45 dB. A total of 28,380 (1,073 per 100,000) disability adjusted life years (DALYs) were estimated as lost annually by application of previously identified relative risk functions and disability weights for IHD, high annoyance and sleep disturbance.

28980 - Overview of a series of systematic reviews on auditory and non-auditory impacts of noise

11. Health impact assessment/Burden of Disease
Keywords: Systematic review, occupational noise, recreational noise, community noise, health effects
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Noise is a substantial but underrecognized public health threat. To help characterize the auditory and non-auditory impacts of occupational, recreational, and community noise exposures, the US Centers for Disease Control and Prevention commissioned our research team to conduct 11 systematic reviews of health effects potentially associated with noise. These health effects were: cancer; cognitive effects; endocrine disruption; hypertension; injuries; ischemic heart disease; low birth weight/premature birth; mental health and psychological effects; noise-induced hearing loss; obesity/overweight; and sleep disturbance. The number of relevant studies identified through our literature search varied widely by health effect, from 10 for cancer to 65 for high blood pressure. Our systematic review methodology indicated high confidence in an association between noise and three of the 11 health effects: ischemic heart disease, sleep disturbance, and injuries. We found with moderate confidence an association between noise and three additional effects: cognitive impacts, hypertension, and mental health and psychological effects. Our results suggest that the impacts of noise extend well beyond noise-induced hearing loss, and highlight the need for further research and policymaking focused on noise exposures.

29025 - Mapping the Health Impact of Road Traffic Noise Exposure in Stockholm County

11. Health impact assessment/Burden of Disease
Keywords: Traffic noise, visualization, health impact
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Road traffic noise exposure is an important environmental health risk, associated with an increased risk of ischemic heart disease (IHD) and other adverse health outcomes. Estimating noise exposure with high geographical resolution in large areas is challenging, requiring major computational resources and large amounts of detailed input data on traffic flows, terrain and buildings. We have modelled residential road traffic noise exposure for the 2.3 million inhabitants in Stockholm County for 2015 in a 100 by 100 m grid using a simplified Nordic prediction model that reduces the computational resources and input data needed. About 430000 inhabitants, or 19%, were exposed above 55 dB day-evening-night. Based on this exposure assessment we estimated the number of incident cases of IHD in Stockholm County due to road traffic noise and disability adjusted life-years (DALYs) lost, to around 2% of all cases and 450 DALYs. We also produced maps showing which areas are the main producers of the health impact, a DALY density map for IHD, based on a combination of the exposure and the population density over the county.

29039 - Estimating noise exposure for burden of disease calculations in country-sized areas

11. Health impact assessment/Burden of Disease
Keywords: burden of disease, noise exposure, traffic noise
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Estimating noise levels at high resolution over large geographical areas is challenging due to both computational resources and the large amount of detailed input data needed. Traditional calculation methods used for urban planning use terrain, building outlines and detailed traffic flow data to calculate the noise level at exposed facades, and were previously used mainly for detailed analysis at the city block level. Better computer performance and better traffic data availability now make it possible to calculate over a whole city. For even larger areas, such as whole countries, simplified methods have been developed. The key issue then becomes the data availability, which is most challenging in low-income countries. By comparing simplified approaches with traditional methods the uncertainty of simplified assumptions, based on overall traffic data and low-resolution population data can be estimated. Still, the major challenge for a global estimation is data availability. However, more and more data is available on large global platforms such as google maps, and remote sensing techniques for population and traffic flows are improving.

33736 - Burden of disease due to transportation noise in the Nordic countries – a NordSOUND study

11. Health impact assessment/Burden of Disease
Keywords: Burden of Disease, transportation noise, health impact
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The burden of disease (BoD) due to road and rail traffic noise was estimated for four Nordic countries and their capital cities, in terms of DALYs (Disability-Adjusted Life Years). Available noise exposure data were used, including data from the strategic noise mapping for 2016 conducted according to the Environmental Noise Directive, END (Directive 2002/49/EC). High degree of annoyance (HA), high degree of sleep disturbance (HSD) and ischaemic heart disease (IHD) were included in the analyses based on exposure-response functions from the WHO systematic review (WHO, 2018). Country-specific estimates from the Global Burden of Disease (GBD) study were used as background health data for IHD. The DALY rates for road traffic noise varied considerably between the Nordic countries, from 72 DALY/100,000 in Finland to 162 DALY/100,000 in Denmark. The burden attributable to railway noise was much lower, with the lowest rate in Denmark (16 DALY/100,000) and the highest in Sweden (53 DALY/100,000). Since several aspects of the noise exposure modelling vary considerably between the Nordic countries, harmonization of noise exposure modelling is important to assure comparative BoD assessment.

Poster

1. Noise-induced hearing loss

28626 - Association between middle-ear muscle reflex thresholds and noise exposure: a possible technique for the evaluation of cochlear synaptopathy in humans

1. Noise-induced hearing loss
Keywords: Cochlear synaptopathy, hidden hearing loss, middle-ear-muscle reflex, acoustic reflex
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In the animal model, cochlear synaptopathy is characterized by a loss of synaptic ribbons and a selective destruction of neuronal fibers following noise exposure. It has been hypothesized that this loss of neuronal fibers can cause an increase in middle-ear muscle reflex (MEMR) thresholds. The aim of this study was to determine a possible association between noise exposure and MEMR thresholds as a possible technique to investigate cochlear synaptopathy in humans.

Forty young factory workers and forty non-exposed control subjects from China were recruited. All subjects presented with normal hearing thresholds (250-8000 Hz) and presence of distortion product otoacoustic emissions. MEMR thresholds at 500, 1000 and 2000 Hz were obtained in the better ear.

The results showed that noise-exposed workers presented with significantly higher MEMR thresholds than control subjects when adjusting for age and pure-tone thresholds. These results suggest that MEMR thresholds may be associated with cochlear synaptopathy. Thus, the MEMR is a non-invasive procedure that can potentially be used to evaluate cochlear synaptopathy in humans. Further studies in this research field are still needed.

28836 - Risk factors for tinnitus among adolescents

1. Noise-induced hearing loss
Keywords: noise, tinnitus, adolescent, risk
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Tinnitus has for a long time been considered as an accompanying symptom of numerous diseases, mainly hearing impairment and predominantly among elderly. It occurs at least once in a lifetime in the one third of a general population, but in 10-15% of the adult population tinnitus is chronic. Since recently, due to the apperance of new environmental noise sources, the prevalence of tinnitus is ever increasing in the younger population, with a wide range, from 6% to 42%. Studies among adolescents indicate that the odds for tinnitus increase with age, in females, and with a previous hearing loss and after a chronic exposure to noise. Furthermore, drug addiction primarily to marijuana and among male adolescents and the exposure to environmental tobacco smoke among females may be independent risk factors for tinnitus. There are inconsistent research results concerning the relationship between adolescents' tinnitus and a high body mass index, alcohol consumption, stress, middle ear infections, excessive use of earphones and heredity.

28865 - Are children's hearing function affected by the preschool acoustic environment? Results from pilot studies and plans for more extensive studies.

1. Noise-induced hearing loss
Keywords: preschool, child, hearing, acoustic environment, noise
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Over 90% of all 4-5-year-old children in Sweden spend most of their awake time at preschool. The room- acoustic standards used in preschools are designed for schools and might not capture the acoustic needs of the preschool environment.

With the aim of identifying risk of noise-induced hearing problems among preschool children, our research team carried out two preparatory studies in 2015 and 2017. Noise levels were measured using stationary measurements and personal dosimeters. Changes in hearing function after exposure to loud sounds were measured with Distortion Product Otoacoustic Emissions (DPOAE). Results from the first study show reduced function at 6 kHz (right ear) and mean amplitude reduction of 2.59 dB $p<0.05$, after a day at preschool. Results from the second study show reduction of similar effects sizes as the first study but with the most apparent and significant impact at 3 and 4 kHz (right ear). The pilot studies have formed a base for a current more extensive study that continues to examine the risk for reduced hearing function, discomfort and stress among preschool children related to the acoustic environment.

28947 - Noise pollution in Rajshahi city and increased deafness among inhabitants

1. Noise-induced hearing loss
Keywords: noise, Rajshahi, pollution
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Background: Like many other megacities of developing countries, noise pollution in the Rajshahi city of Bangladesh is a big concern. Here noise is produced from different sources like traffic, loudspeaker, people gathering, etc. Exposure to high-level noise may cause severe stress on the auditory and nervous system of the city dwellers. Deafness is a major public health problem in Bangladesh.

Methods: This study reports the level of noise pollution & its effect on deafness in Rajshahi city. For this purpose noise levels have been measured at six major locations of the city from 7 AM to 10 PM during the working days. The data were collected by using a structured questionnaire selected to understand their opinion about noise pollution, the problems they experience, and what they feel should be done. The printed question paper related to deafness along with multiple answers to choose was distributed among the respondents and no attempt was taken to influence their response. This study is based on a survey conducted in different areas of Rajshahi city in July-August 2019. A total of 500 persons (city-dwellers) took part in the survey. The data have been analyzed to calculate various noise parameters such as Leq and Lnp.

Results: It is observed that at all the locations, the level of noise remains far above the acceptable limit for all the time. There are various causes of deafness in Rajshahi city. Chronic Otitis Media (CSOM) and otitis media effusion are the commonest acquired causes and the prevalence of CSOM appears at 20.05%.

Conclusion: The study suggests that urgent measures should be taken into consideration to control the level of noise pollution in the city.

28960 - NIHL and Prevention: Getting Youth to Listen and Act

1. Noise-induced hearing loss
Keywords: NIHL, prevention, education, outreach, youth
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1.1 billion young adults are at risk for Noise-Induced Hearing Loss (NIHL) from damaging levels of sound with one in five U.S. teens having permanent hearing damage by age 19. This worldwide epidemic of NIHL has serious short- and long-term consequences for health. Unfortunately, young people associate hearing loss with illness and old age, causing them to discount its danger for them. Since 2020 is "The International Year of Sound," it's the perfect time for international education and outreach about NIHL and to advocate for action regarding this public health crisis.

How can we change how young people think about noise exposure, hearing loss, and prevention? We'll discuss key ways to spread the message about NIHL and hearing preservation such as safe listening practices, motivating young people, use of social media (e.g. Instagram, YouTube, etc.); reaching children early; integration of safe-hearing education into school curriculums (e.g. Ear Peace Foundation's Protect-a-Band program); promotion of the WHO's Make Listening Safe partnership program with the ITU; and, especially, recruiting young advocates to spread the word about hearing. When young people speak, kids listen!

29028 - A pilot study of cochlear synaptopathy in military recruits

1. Noise-induced hearing loss
Keywords: Cochlear synaptopathy, hidden hearing loss, noise, speech-in-noise, frequency selectivity
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Speech-in-noise difficulties could be associated with cochlear synaptopathy. In this study, we investigated speech-in-noise and frequency selectivity in young adults exposed to impulse noise.

Ten young military recruits with exposure to firearm noise and 10 non-exposed control subjects were recruited. Subjects presented with normal hearing thresholds and presence of distortion product otoacoustic emissions. The Noise Exposure Structured Interview was used to quantify noise exposure. Speech-in-noise and frequency selectivity tests were carried in the better ear. While speech-in-noise performances were not different between groups, frequency selectivity at 4 kHz was significantly worse in the firearm-exposed group, even when controlling for hearing threshold ($p=0.008$). A significant correlation was found between noise exposure and frequency selectivity ($p=0.015$), but not with speech-in noise performances.

These results suggest that young military recruits with firearm exposure present worse frequency selectivity than peers without noise exposure, despite normal hearing thresholds and the presence of otoacoustic emissions. Impairment of frequency selectivity in presence of normal hearing could reflect hidden damage to inner ear cells or auditory nerve fibers. This procedure could allow the detection of cochlear synaptopathy.

33748 - OCCUPATIONAL NOISE-INDUCED HEARING LOSS AMONG WORKERS IN CHURCH AND NIGHT-CLUB IN KUMASI, GHANA

1. Noise-induced hearing loss

Keywords: . environmental noise; occupational noise-induced hearing loss; electroacoustic; environmental healt

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Certain indoor in Ghana, such as nightclubs and churches are characterized by high levels of noise (Leq), which can be consider
as a physical hazard.
These suggest that workers in leisure and religious sites may be expose to potentially damaging noise levels from loudspeakers. However, there is a lack of information on the daily risk of exposure to occupational noise and potential hearing loss among workers in church and nightclub in Kumasi, Ghana.
Here, we demonstrate that noise levels from loudspeaker have potential risk of hearing loss by measurement of daily noise dose percentage and noise level (Leq) during daily working hours using an ER-200DW8 personal dosimeter.
The methodology involved physical examination of the ear. It was found that Nightclub workers were exposed to (noise level) Leq at 103.36 dBA and above whiles the church workers Leq were measured at 101.43 dBA and above respectively.
About 33.9%, 18.2%, 4.5% and 43.9% of workers had mild, moderate, severe and normal hearing loss respectively.
Due to the very low knowledge regarding hearing protection it recommended to use soundproof and hearing protection aids.

34038 - The demise of subject-fit testing and the consequences

1. Noise-induced hearing loss
Keywords: Protector, Testing, Methods, Noise
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In 2004 it seemed as if the subject-fit test method of ANSI S12.6 was going to be adopted to revise the U.S. EPA's revised hearing protector labeling rule. However, in 2010 the U.S. EPA published its draft proposed rule that maintained that switched to back to a version of experimenter-fit testing. What was missed was that the data collected for the support of the development of the rule showed that the subject-fit test method allowed observation of the protectors' worst and best outcomes. In contrast, the experimenter-fit method showed only the best.

The data from multiple studies that evaluated both test methods will be presented along with meta-analyses that compare and contrast the two methods. Possibilities for the consideration of various test methods for labeling purposes will be discussed.

2. Noise and communication

34017 - Application of Hearingloop -Hearing aid for hearing-impaired people and utilization for entertainment-

2. Noise and communication
Keywords: Hearing loop, hearing aid for hearing-impaired people, elderly people, entertainment
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The main target of the “hearing loop” is hearing-impaired and elderly people, and the purpose is to support hearing loss. However, there are situations where it is difficult to hear the conversation even in a space with excessive reverberation, when wearing a mask due to the recent corona sickness, and even under an acrylic partition. In addition, the number of people with auditory processing disorder (APD) is increasing in the world. We have tried to support and apply the hearing loop under various situations by utilizing the characteristics of the hearing group introduced in the previous report, which are difficult to hear in these situations.

34022 - Vocal problems among nurses working in the intensive care unit during the COVID-19 pandemic in China

2. Noise and communication
Keywords: ICU, acoustic environment, vocal problem
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This study explored the effects of noise on medical staff in intensive care units (ICUs) in China during the COVID-19 pandemic. Firstly, noise levels were measured for 24 hours in four ICUs and noise sources were identified. Secondly, Speech transmission through face masks that the nurses wear was tested in the laboratory. Thirdly, online questionnaire surveys were conducted to analyze the self-rated vocal perception of the ICU nurses who wore face masks. Participants were recruited from four ICUs and around 20-30 nurses from each ICU took part in the surveys. Lastly, the voice-related parameters were measured by using a monitor in four ICUs. For this, a non-invasive accelerometer was attached to a participant's neck during working hours. This paper will show the self-rated vocal effort, difficulty in speech, and perceived acoustic environments of the ICUs. Also, the relationships between the objective measures on voice and perceived vocal problems will be presented. The findings could provide more understanding of the vocal problems of the staff who is working in the ICUs by wearing the face masks during the COVID-19 pandemic.

3. Non-auditory health effects of noise

28583 - A study on non-auditory health effects of noise exposure among urban residents of eastern Nepal

3. Non-auditory health effects of noise
Keywords: Common non-auditory health effects, Traffic noise exposure, urban residents
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Background: Negative health outcomes like hypertension, annoyance, stress, sleep disturbances, and mental health effects are associated with noise pollution.
Objective: This study was designed to investigate the association between road traffic noise and non-auditory health effects among urban residents of Eastern Nepal.
Methodology: A comparative cross-sectional study enrolled 660 adults (330 residents residing within 100m from main trunk road and other 330 residents in side streets) in cities Biratnagar and Itahari. Purposive sampling was used. Time-weighted equivalent noise level was estimated using a standard procedure. Pretested semi-structured questionnaire was administered by face-face interview.
Results: Significant association was seen with depression (p=0.001), anxiety (p=0.007) and stress (p=0.034) between residents of main trunk road and side streets. Noise exposure, type of house, physical activity, and presence of health problems were strong predictor of anxiety while age, gender, religion, ethnicity, BMI, physical activity and family history of hypertension were the predictors for hypertension.
Conclusion: Exposure to road traffic noise is associated with depression, anxiety and stress. Noise pollution has become a major issue and needs to be addressed by the Government of Nepal.

28597 - Research on the impacts of wind turbine noise on humans: sound, perception, health (RIBEolh)

3. Non-auditory health effects of noise
Keywords: wind turbine noise, infrasounds, low-frequency sounds, health, perception
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Wind energy is expanding rapidly in France as elsewhere in the world, but the population is worried about the health impacts of wind turbine noise and some people are more annoyed than the sound field measurements would suggest. The annoyance is often described as resulting from infrasounds (IS) whereas the acoustic pressures of IS emitted by wind turbines would be below the perception thresholds. However, the possible inaudibility of IS does not exclude their action on the inner ear or the central nervous system (CNS). In this context, we propose a research on the impacts of wind turbine noise on humans: sound, perception, health (RIBEolh). The objectives are:
- To assess the health effects of audible noise, in particular low-frequency sounds (LFS), and IS, emitted by wind turbines.
- To better understand the auditory mechanisms associated with the perception of IS and LFS emitted by wind turbines.
- To better understand the effects of IS on the inner ear or CNS.
To address these objectives, RIBEolh is based on two complementary parts: an epidemiological study and a psychoacoustic and physiological study.

28698 - Impact of noise pollution on health related quality of life among elderly in rural India

3. Non-auditory health effects of noise
Keywords: Quality of life, Noise, Rural, India
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Background
Exposure to loud noise in residential areas can lead to serious health problems in geriatric age group. This study was planned to investigate the effect of noise pollution on health related quality of life among older people in rural areas of Northern India.

Materials and methods
A population based cross sectional study was conducted in selected rural areas of Northern India among apparently healthy individuals aged more than 60 years of age. Those who were bed ridden due to terminal illness and with any acute condition were excluded. Data was collected regarding their health related quality of life and noise levels in their respective residential areas.

Results
A total of 360 participants were included in the study. There was significant negative correlation between ($p<0.05$) health related quality of life and noise pollution levels after adjusting with gender, per capita income and educational level. Stronger association was seen with mental health component.

Conclusion
Noise pollution contributes to lower health related quality of life scores among elderly. Measures should be taken to reduce noise levels in and around residences.

28762 - The role of aircraft noise annoyance and noise sensitivity in the association between aircraft noise exposure and saliva cortisol levels

3. Non-auditory health effects of noise
Keywords: epidemiology, aircraft noise annoyance, cortisol levels, Europe
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The HYDE study combined HYENA (HYpertension and Exposure to Noise near Airports) and DEBATS (Discussion on the health effects of aircraft noise) datasets. It previously showed significant associations between aircraft noise levels and cortisol outcomes in women, but not in men. The present study aims to assess the role of aircraft noise annoyance and noise sensitivity in these latter associations. Cortisol levels were determined in saliva samples, provided for 439 and 954 participants in HYENA and DEBATS respectively. Information on demographic and lifestyle factors, aircraft noise annoyance, and noise sensitivity was collected during a face-to-face interview. After adjustment for aircraft noise annoyance or noise sensitivity, previous results were unchanged. However associations between aircraft noise levels and cortisol outcomes tended to be stronger in participants highly annoyed or highly sensitive to noise, showing a flattening in the (absolute and relative) variations per hour in cortisol levels with higher noise levels. These results suggest a modifying effect of annoyance and of noise sensitivity in the association between aircraft noise levels and cortisol outcomes. Nevertheless, they need to be confirmed.

28805 - Relationship between noise exposure and physical stress in spontaneous abortion: systematic review of literature

3. Non-auditory health effects of noise
Keywords: Noise exposure, physical stress, spontaneous abortion
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The objective of this study was to analyze the association between spontaneous abortion and auditory and physical stress. Systematic review selected in databases: Scielo, Pubmed, and The Cochrane Library according to Descriptors in Health Sciences, from 2009 to 2019. Only one article was selected for review. This article examined the effect of both types of gestational stress on uterine receptivity and behavioral performance. Mice were randomly assigned to either physical or auditory stress conditions or a control condition from gestational days 12-16, with high-pitched auditory stress of 3000 Hz, while physical stress consisted of restriction and exposure to a raised platform. Uterine receptivity was investigated by counting the number of implantation sites and fetal resorption. Auditory stress caused higher rates of reabsorbed embryos and reduced litter size. These results suggest that adverse effect of noise stress is stronger than physical stress in spontaneous abortion.

28923 - Road traffic noise, air pollution and cardiovascular events in a Swedish cohort

3. Non-auditory health effects of noise
Keywords: traffic noise, air pollution, cardiovascular disease, epidemiology
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Road traffic causes exposure to both noise and air pollution. Air pollutants have decreased in Sweden the past decades but traffic noise increased. For both exposures associations with cardiovascular disease are established, but most studies only use one of the two highly spatially correlated exposures.

The Swedish Primary Prevention Study cohort of men aged 47 to 55 were first examined in 1970 to 1973. We assigned annual modelled residential exposure to road traffic noise and nitric oxides (NO_x), and retrieved outcomes from the Swedish patient registry 1970-2011. Associations with cardiovascular events using Cox proportional hazards model with time-varying exposures.

The risk of cardiovascular disease was not significantly increased by long-term road traffic noise, after adjustment for air pollution. Hazard ratios were 1.08 (95% CI 0.90-1.28) for cardiovascular mortality, 1.14 (95% CI 0.96-1.36) for ischemic heart disease and 1.07 (95% CI 0.85-1.36) for stroke, for noise above 60 dB vs below 50 dB. For stroke the association with noise was weakened by including air pollution in the model, but not for the other outcomes.

28971 - Occupational exposure to noise in relation to pregnancy-related hypertensive disorders and diabetes

3. Non-auditory health effects of noise
Keywords: occupational noise, pregnancy, hypertensive disorders, gestational diabetes
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Background: Research has yet to fully elucidate the causes of hypertensive disorders of pregnancy (HDP) and gestational diabetes. Our objective was to explore the association between occupational noise exposure and these pregnancy disorders.

Methods: We utilized data on 1,109,516 singletons born to working mothers in Sweden between 1994 and 2014 from the Medical Birth Register. Noise exposure came from a job exposure matrix (JEM) in five categories <70, 70-74, 75-80, 80-85, >85 dB(A). Relative risks, adjusted for confounders and other job exposures, were calculated.

Results: Preliminary results show that among first-time pregnant women working full-time, exposure to 80-85 dB(A) of noise had a statistically significant increased risk of all HDP (RR: 1.12) as well as for preeclampsia alone (RR: 1.14). Exposure to 80-85 and > 85 dB(A) of noise were associated with a statistically significant increased risk of gestational diabetes (RR: 1.23 and 1.57, respectively).

Conclusion: Exposure to noise may be associated with an increased risk for pregnancy disorders. Additional studies are needed to confirm this association, as well as investigate whether hearing protection can mitigate these risks.

29003 - Road traffic noise and incident stroke in the Danish Nurse Cohort

3. Non-auditory health effects of noise
Keywords: Road traffic noise, stroke, cardiovascular disease, Danish Nurse Cohort
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Background: Evidence links long-term exposure to transportation noise with cardiovascular diseases, though few studies have investigated associations with stroke.

Methods: Associations between long-term exposure to road traffic noise (up to 23 years) and stroke incidence (all, ischemic and hemorrhagic), among 23,432 Danish Nurse Cohort participants, were investigated with time-varying Cox regression models adjusted for stroke risk factors and air pollution. Road traffic noise (L_{den}) was estimated using the Nord2000 model. Further, the World Health Organization and Danish government's respective maximum exposure recommendations of 53 and 58 dB, were explored as potential thresholds.

Results: For associations between the 1-year mean of L_{den} and stroke incidence, the estimated hazard ratio (HR) (95% confidence intervals), in the fully adjusted model was 1.06 (0.99-1.14) per 10 dB. This was attenuated to 1.01 (0.93-1.09) and 0.98 (0.89-1.07), in models further adjusted for particulate matter <2.5 $\mu g/m^3$ ($PM_{2.5}$) and nitrogen dioxide (NO_2), respectively. Associations with ischemic or hemorrhagic stroke were not observed, and there were no suggestions of threshold effects.

Conclusion: Road traffic noise was not associated with incident stroke in the Danish Nurse Cohort.

29034 - Occupational noise and hypertension – a cross-sectional study on Swedish women

3. Non-auditory health effects of noise
Keywords: Occupational noise, women, hypertension
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The detrimental effects of occupational noise exposure on hypertension have been previously demonstrated, with the majority being performed on men. Apart from occupational exposure level, socio economic factors such as education might modify the risk. Female-dominated workplaces, such as preschool and healthcare, often comprise a sound environment that demand the workers' attention. This is different from for instance industrial work where the sound input should often be disregarded or attenuated by hearing protection. Our study aims to investigate the effect of self-reported occupational noise exposure on the prevalence of self-reported physician diagnosed hypertension in women and to assess whether this effect was influenced by participants' educational level, controlling for sociodemographic and life style factors. Data was collected by self-assessment questionnaires and logistic regression was used for analysis. Occupational noise exposure was associated with increased hypertension prevalence in women (OR 1.19; 95% CI 1.03-1.38) especially in the highest educated subgroup (OR 1.27; 95% CI 1.06-1.52). Findings contribute to the understanding of how occupational noise might affect health and suggest that preventive measures should take into account work demands and gender perspectives.

29052 - Mapping physiological stress responses to environmental noise

3. Non-auditory health effects of noise
Keywords: stress responses, stress, environmental noise, mapping
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Abstract: Population exposure to environmental noise is now an established issue for public health and over the past decade wide-ranging non-auditory health effects of exposure have been investigated. Studies have variously identified evidence for exposure to, in particular, transportation noise and a related increased risk of cardiovascular and metabolic complication, immune system dysfunction, depression, anxiety, and cognitive impairment in children. More recent emerging studies have begun to identify links between environmental noise and cognitive function in adults, fertility, gestational diabetes, fetal, infant, and child development, and various cancers. With a view to outlining the potential pathologies for wide-ranging noise-health outcomes, and drawing on recent research, we propose a flow diagram which maps potential physiological response pathways resulting from exposure to environmental noise as a stressor.

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29075 - Investigation on the association between aircraft noise and general health of residents living near Tan Son Nhat Airport

3. Non-auditory health effects of noise
Keywords: .
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Tan Son Nhat International Airport (TIA) is Vietnam's largest airport with more than 700 take-offs and landings per day and is surrounded by densely populated areas of Ho Chi Minh City. A health survey was carried out to investigate the association of aircraft noise with the prevalence of annoyance, insomnia and other risks of physical and mental health problems such as obesity, hypertension, stress, depression and so on in the community living near TIA in August 2019. In total, 501 responses obtained in 12 residential areas including ten target sites which scattered under the landing and take-off route of the airplanes and exposed to different aircraft noise ranging from low to high levels, and two control sites which are not affected by aircraft noise. Out of 294 in the total of 501 respondents exposed to day-evening-night noise levels of above 65 dB. The results of multiple logistic regression analysis showed that aircraft noise significantly affected the prevalence of annoyance but have no direct effect on insomnia and hypertension. The indirect effect of noise on other health indicators is also investigated.

33676 - Long-term exposure to transportation noise and risk for atrial fibrillation: a Danish nationwide cohort study

3. Non-auditory health effects of noise
Keywords: Epidemiology, Cardiovascular Disease, Heart, Cohort
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Background: Epidemiological studies have linked transportation noise and cardiovascular diseases, however, atrial fibrillation (AF) has received limited attention. We aimed to investigate the association between transportation noise and AF risk.

Methods: Road and railway noise at the most and least exposed façades were estimated for all addresses across Denmark. Time-weighted mean noise exposure for 3.6 million individuals age >35 years were estimated. Of these, 269,756 incident cases of AF were identified. Analyses were conducted using Cox proportional hazards models with adjustment for covariates and air pollution.

Results: A 10 dB higher 10-year mean road traffic noise at the most and least exposed façades were associated with IRR and 95% CIs for AF of 1.006 (1.001-1.011) and 1.013 (1.007-1.019), respectively. For railway noise, the IRRs per 10 dB increase in 10-year mean exposure were 1.017 (1.007-1.026) and 1.035 (1.021-1.050) for the most and least exposed façades, respectively. High levels of aircraft noise was associated with a small increase in AF risk.

Conclusion: Transportation seems to be associated with a small increase AF risk, especially for exposure at the least exposed façade.

33840 - Does air pollution confound associations between environmental noise and cardiometabolic outcomes? - a systematic review

3. Non-auditory health effects of noise
Keywords: Environmental Noise Exposure, Air Pollution, Cardiovascular, Metabolic, Systematic Review
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Background - Exposure to road traffic noise can lead to adverse health effects. It is important to understand how associations may be affected by air pollution exposure.

Objectives - To update the current state of evidence on environmental noise on cardiometabolic outcomes, evaluating both confounding and interactions with air pollution.

Methods - Papers were identified from previous reviews from 2013 and 2015, reviews for the WHO 2018 noise guidelines and a literature search 2016-2020, using Medline and PubMed databases. Additional papers were identified from colleagues. Study selection was according to PECOS inclusion criteria. Studies were evaluated against a checklist for risk of bias.

Results - 81 publications were identified. Most, but not all, papers suggested independent associations of air pollution and noise but only nine provided quantitative estimates of interaction. Several of these found highest associations in highest air pollution – highest noise strata.

Conclusions - Current methods to assess quality of evidence of associations are not optimal when evaluating confounding. More studies are needed that examine interactions between noise and air pollution, which may occur whether or not there is confounding.

33979 - General health in relation to perceived acoustic environment during the COVID-19 home quarantine

3. Non-auditory health effects of noise
Keywords: environmental sensitivity; indoor environment; low frequency noise; nature sounds; self-rated health
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In this study, we seek to understand how indoor soundscape related to university students' general health in Bulgaria around the time that the country was under a state of emergency declaration caused by the COVID-19 pandemic. Between 17 May and 10 June 2020, we conducted a cross-sectional online survey among 323 students from two universities in the city of Plovdiv, Bulgaria. Self-rated health (SRH) was measured with a single-item. Participants were asked how frequently they heard different types of sounds while at home and how pleasant they considered each of those sounds to be. Restorative quality of the home was measured with a single-item. Exploratory factor analysis supported grouping perceived sounds into mechanical, human, and nature sounds. Results indicated that greater exposure to mechanical sounds was consistently associated with worse SRH. In addition, exposure to mechanical sounds related to lower restorative quality of the home, and then to pooper SRH, whereas nature sounds correlated with higher restorative quality, and in turn with better SRH. These findings support the importance of indoor soundscape for shaping health in times of social distancing.

4. Effects of noise on cognition, performance and behaviour

26830 - A study of differences in ERP under meaingful of meaningless noise by multivariate analysis

4. Effects of noise on cognition, performance and behaviour
Keywords: Meaningful noise, Meaningless noise, ERP, Selevtive attention, PCA
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The presence of noise during the performance of cognitive tasks involving such as memory, commonly causes a subjective experience of annoyance, which can lead to a decline in performance. In designing a comfortable sound environment, it is important to understand the relationship between not only the measurable aspects of noise, such as the sound pressure level, but also the qualitative aspects, such as the degree of meaningfulness of the noise, and the subjective experience of annoyance. On the other hand, it is well known that the Event-Related Potential (ERP) in the brain wave elicited by internal or external stimuli are related to the operation of selective attention. The present experiment was designed to determine the effects of meaningfulness of the external noise on selective attention. First, we examined differences in the ERP components during the odd-ball paradigms under the meaningful noise or meaningless noise by using the multivariate analysis such as Principal Component Analysis (PCA).

27732 - A Novel Representation of the Noise Attribute for Discrete Choice Valuations of Aircraft Noise

4. Effects of noise on cognition, performance and behaviour
Keywords: Aircraft Noise, Willingness to Pay, Choice Experiment, Noise Attribute
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We contribute to existing aircraft noise valuation research by developing a new attribute for noise representation in Discrete Choice Experiments on aircraft noise. Most previous studies place significant cognitive burden on participants by using fictional noise exposure scenarios to choose from. We exploit the differences in noise characteristics of departing and landing aircraft and let participants choose between exclusively experiencing either scenario. Both scenarios have been experienced by participants in the weeks before the survey and potentially allow for a less abstract representation of the noise attribute in the experiment. On an individual level, we find WTPs for either landing or departing aircrafts. Although we could not find a collective preference for either landing or departing aircraft, our findings imply the practicality of using those two scenarios as a representation of the noise attribute in future Choice Experiments to minimize cognitive burden.

28003 - Perceptions of noise exposure, information overload, and the wellbeing of workers

4. Effects of noise on cognition, performance and behaviour
Keywords: Noise, information overload, wellbeing, workers
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The present research considers noise exposure as a component of information overload which may have a negative impact on wellbeing. 253 workers completed a survey consisting of an information overload scale (IOS) and the well-being process questionnaire. The IOS scale included questions relating to noise exposure and these were compared with other factors increasing information overload. Both the noise scores and non-noise IOS scores were associated with greater negative well-being (more stress, anxiety and depression) and lower positive well-being (happiness, positive affect, and life satisfaction). Well-being has been shown to be predicted by a number of factors such as exposure to stressors, negative coping, social support and psychological capital (self-efficacy, self-esteem and optimism). When these established factors were included in the analyses the effects of noise-related IOS could be accounted for by other significant predictors of negative (negative job characteristics, negative coping) or positive (psychological capital, positive job characteristics) wellbeing.

28010 - Noise exposure, satisfaction with the working environment, and the wellbeing process

4. Effects of noise on cognition, performance and behaviour
Keywords: Noise, satisfaction with the working environment, wellbeing process
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Much of the early research on noise at work was conducted in factories and jobs where the noise was often a risk to hearing. More recent research has focused on quieter office noise and a major problem has been the lack of control of other aspects of the working environment (e.g. lighting; layout and density). Research on noise and wellbeing has also failed to control for established predictors such as job characteristics, personality and health-related behaviours. In addition, both positive (e.g. happiness, life satisfaction) and negative aspects (e.g. stress, anxiety and depression) of wellbeing should be measured. The present study rectified the problems with previous research and involved a survey of 215 office workers. They completed questionnaires measuring noise exposure, satisfaction with the working environment, and the wellbeing process. The results showed that exposure to noise predicted negative wellbeing but not positive wellbeing. In contrast, environmental satisfaction predicted positive wellbeing but not negative wellbeing. These effects remained significant when personality, health-related behaviours and job characteristics were included in the analyses.

28640 - A research proposal on physiological parameters determining effort during cognitive tasks in a noisy work environment

4. Effects of noise on cognition, performance and behaviour
Keywords: physiological procedures, cognitive task, effort, noisy work environment
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In studies on effects of noise on cognitive tasks, procedures providing information about physiological parameters during task performance may complement the performance data and results regarding the experienced effort. In comparison to the performance measures themselves, there is less experience in the use of physiological or neurophysiological procedures in studies on acute noise effects.

The aim of the planned research project is to explore in a systematic way which (neuro)physiological procedures and measures would be most appropriate to answer the questions for realistic working situations, (1) whether or to what extent effort is generally increased for task processing under background noise in comparison to a more silent condition, and (2) whether increased effort may also be present even when no detrimental effects of noise on performance are found.

The roadmap of the granted project will be presented. The schedule includes amongst others a systematic review of the relevant literature and a scientific workshop on this topic.

33997 - Overall environmental assessment with soundscape and landscape indices in urban parks

4. Effects of noise on cognition, performance and behaviour
Keywords: Soundscape index, Landscape index, Audio-visual interaction, Satisfaction, Recognition model
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In this study, soundscape and landscape indices that can be used for overall environment assessment of urban parks are proposed, and the effects of audiovisual interactions are examined. In a virtual reality evaluation environment reproduced based on audio-visual data collected from three parks in Paris, audio-visual element identification, perceived affective quality, and overall environmental assessment (OEA) for a total of 30 subjects. Based on this, reference indices (Green soundscape index (GSI), Red soundscape index (RSI), Green landscape index (GLI), Red landscape index (RLI))) are defined based on the ratio of the audio-visual perception of nature and traffic or nature and people. In addition, Revised reference indices (OEA) were proposed. Finally, environmental awareness models using structural equation model were presented. As a result, it was found that acoustic and visual satisfaction had 79 % and 21 % effect on overall environmental satisfaction, respectively. In addition, in order to increase acoustic and visual satisfaction, GLI should be increased and RLI should be decreased, and it was found that visual satisfaction can be improved when GSI is additionally increased.

5. Effects of noise on sleep

28467 - Exposure-response relationship of self-reported sleep disturbance derived from Japanese socio-acoustic surveys

5. Effects of noise on sleep
Keywords: Sleep disturbance, Social survey, Meta-analysis, Road traffic noise, Railway noise
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Socio-Acoustic Survey Data Archive (SASDA), established in 2011 under the Institute of Noise Control Engineering, Japan, is a data archive that accumulates social survey data on community responses to environmental noise throughout Japan. This paper reports exposure-response relationships based on self-reported sleep disturbances due to road traffic, railway, and Shinkansen noises derived from 29 Japanese datasets included in SASDA. Although the question wording and the number of scale points on the evaluation scales differed among the surveys, the cut-off point as the definition of highly sleep disturbed (HSD) was standardized at 72% for all datasets. Among the noise sources, the highest exposure-response relationship was shown for Shinkansen noise. The response rate of HSD due to road traffic noise was higher than that due to railway noise. The comparison with the results from previous studies based on surveys conducted in western countries will be shown in the poster session.

6. Community response to noise and noise annoyance

28508 - Citizens' perceptual evaluation of noise events in an urban environment

6. Community response to noise and noise annoyance
Keywords: perceptual, annoyance, noise, urban, citizen
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Noise is one of the main environmental pollutants, and it is becoming a public health concern due to its wide impact on quality of life of citizens. Real-time noise monitoring can help authorities in decision-making and policy design to address this problem. In this respect, several Wireless Acoustic Sensor Networks (WASN) have been deployed in European and American countries mainly, focusing on critical locations as in big cities. These networks mainly measure the noise levels associated to road traffic. However, other types of sounds may be found in urban areas. In this work, we propose the analysis of a dataset collected by a WASN in the urban area of Milan, which contains several common noise events such as dogs barking, sirens, horns, trains, among others. In order to evaluate how citizens perceive these sounds we have designed a set of off-line listening tests. Participants are asked not only to rate the degree of annoyance but also other qualities such as pleasantness. Moreover psychoacoustic parameters of the evaluated audios are extracted and compared with the tests results to look for relationships.

28514 - Analysis of Residents' Perceptions on the Residential Noise in terms of Sociality

6. Community response to noise and noise annoyance
Keywords: Residential noise, Perception, Sociality
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The analysis of residents' response to residential noise has been conducted four times since 1986. This study tried to compare how the response to noise is compared with the existing survey results according to the changes in society. Differences in response to noise were compared according to the size of the residential area. In particular, the relationship was analyzed between the sociality and the response to noise, and intended to reflect it in the policy to alleviate noise problems.

28816 - Cultural influences on the perception of noise among South Asian minority communities in New Zealand

6. Community response to noise and noise annoyance
Keywords: Community health, cultural influences, noise exposure, noise annoyance
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Hearing loss is a common debilitating condition but there is limited information that can be used to inform strategies and policies to ensure better hearing-health outcomes for minority and migrant communities. New Zealand and especially Auckland has a growing diverse migrant population. We interviewed 28 South Asian people living in Auckland, New Zealand representing Indian, Fiji Indian and Sri Lankan communities. The responses were transcribed, coded and analysed using thematic analysis. The findings reveal unique societal and cultural influences on how noise is perceived in these communities. The key themes related to (1) loudness being an accepted part of culture; (2) perception of being desensitised to loud noise; and (3) collective noise enjoyment prioritised over individual noise annoyance. They offer insights into how these communities respond to noise exposure and noise annoyance. This research adds foundation-level understanding to the evidence base about South Asian communities in relation to hearing-health. This has implications for local and national-level research outcomes as it may inform the development of tailored and targeted interventions aimed at promoting hearing-health outcomes in minority and migrant communities.

28921 - Gender differences in noise concerns about civil drones

6. Community response to noise and noise annoyance
Keywords: aviation, civil drones, acceptance, noise annoyance, telephone survey
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Rapid technological developments provide people with an increasing number of opportunities for applying civil drones (e.g., rescue operations). However, one crucial aspect for the future use of drones will be their public acceptance. Importantly, drone acceptance is considered to substantially rely on noise concerns. Recent research demonstrated differences between certain groups of individuals (e.g., females vs. males) in their attitudes towards civil drones. By means of a representative telephone survey in Germany (n = 832), we aimed at further investigating the influence of gender on drone acceptance. Chi-square Automatic Interaction Detection (CHAID) revealed noise concerns to be the most important of all assessed concerns for explaining female respondents' attitudes towards civil drones, while concerns about damages/injuries best explained male participants' attitudes. Moreover, our survey corroborates prior studies by showing males to be less concerned about civil drones than females (e.g., regarding noise). Additionally, we explored whether these effects could have been driven by confounding variables (e.g., drone experience). Thus, the present study highlights aspects of gender differences in concerns about drones which need to be examined further in future research.

29029 - A 2-year longitudinal study on noise annoyance related to the construction of a major highway infrastructure

6. Community response to noise and noise annoyance
Keywords: Construction noise, Environmental noise, Annoyance, Health, Social survey
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Few studies have been conducted regarding construction noise annoyance. This paper presents the results of the first two years of a longitudinal study aimed to examine noise annoyance related to a road construction project.

1409 subjects participated in the study in the first year and 855 of them were followed in the second year. Participants were divided in two groups (target 0-300 m and control 300-1000 m) based on the distance of their dwelling to the construction sites. They responded to a socio-acoustic survey.

Overall construction noise annoyance remained similar across the study. But, when looking at annoyance levels specifically by period of day, higher annoyance was reported in the second year for both groups ($p<0.001$). Sleep disturbance from construction noise increased from 23 to 30% in the target group and from 6 to 20% in the control group.

Participants report stable annoyance levels over time, but when questioned according to different periods of the day, annoyance increases between surveys. To avoid missing any variation in annoyance, time periods should be taken into account in socio-acoustic surveys regarding construction noise.

34039 - Rail noise annoyance in a context of low to moderate traffic density

6. Community response to noise and noise annoyance
Keywords: noise, rail, annoyance, survey
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Numerous studies on rail noise annoyance has been conducted in Europe and Asia. In these studies, about a third of the annoyance is accounted for by acoustic factors. The context of railway operations in Quebec shows moderate freight trains traffic density (≈ 0.2 train / hour), small number of passenger's trains and absence of high-speed train. The objective of this socioacoustic survey (n=1506 participants in five Quebec municipalities) was to identify the factors linked to rail noise annoyance in this specific context.

10.6% of subjects, living < 300 m from the nearest railway, reported being highly annoyed by rail noise compared to 2.6% for participants living > 300 m and < 1000 m. Regression models showed that contextual, socio-demographic and personal factors explained between 45 and 55% of the variance to the variable annoyance. Acoustic factors explained much less variance, between 0.6 and 1.4%. These results suggest that, while rail noise annoyance reached similar proportions of exposed population, factors other than noise exert a stronger influence than what has been reported in the European and Asian literature.

7. Noise policy and economics

27495 - Stakeholders interested in noise problems and the lack of interest of governments. Peruvian cases after the industrial impulse using electric power from Amazonian natural gas

7. Noise policy and economics
Keywords: noise, vibration, annoyance, developing countries, stakeholders
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Peru has an on-growing industrialization after the natural gas pipeline from Amazonian Rainforest was installed in 2005; gas-fired power plants have been built around Lima city. This enhanced of supplying electricity, companies and industries started to change their machines for new ones: bigger and noisy. For years in different Lima´s neighborhood, small/middle industries were mixed among residential areas within the same acoustical zone. Because of Lima is next to the Pacific, the Humboldt Current is largely responsible for Lima's lack of rain and its mild temperature, so, this issue has a result not building wright industrial facility, companies are accustomed to build big sheds. In the term of a few months people started to make individual complaints about noise and vibration before municipal Authorities, they didn't get any answer from them for several political reasons, stakeholders group becoming to ask for acoustic mitigation directly to the companies. The most important problem was the vibration, because the houses used the perimetric wall as if it were their own. This Paper presents some of the several private studies conducted for the Authors.

28457 - Policies are needed to protect vulnerable populations with auditory/noise sensitivity

7. Noise policy and economics
Keywords: sensitivity, noise, hearing disorders, developmental disorders, epidemiology
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US policy for those with auditory disorders need to go beyond those with deafness or hearing loss. Auditory/noise sensitivity is common in children and adults with attention deficit hyperactivity disorder (ADHD), autism spectrum disorders (ASD), hearing loss, hyperacusis, tinnitus, sensory processing disorders (SPD), and noise-induced developmental disorders. Exposure to environmental noise may cause immediate mental and physical distress including discomfort, anxiety, aggression, fear, pressure in the ear, and burning pain which, over time, can result in negative physiological changes and functional outcomes. A substantial number of people in the US are afflicted with these conditions (ADHD: >12 million; ASD: >8 million; hearing loss: 48 million; hyperacusis: 20-50 million; tinnitus: 18-36 million; SPD: 16-55 million). Uncertainty in overlap among conditions (e.g., ADHD/ASD/SPD; hearing loss/tinnitus/hyperacusis) and percent affected make it difficult to estimate the total with auditory/noise sensitivity. However, the numbers suggest that health and quality of life for tens of millions of Americans are at risk from exposure to excessive environmental noise. Awareness of the size of these populations and the negative effects of noise should be used to inform policies.

8. Noise exposure assessment in health effect studies

27835 - Frequency band distribution and decibels are both needed to understand noise impacts

8. Noise exposure assessment in health effect studies
Keywords: noise impacts, health, decibels, frequency band distribution, metrics
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Although the decibel is the most common metric used to characterize environmental noise, other characteristics are sometimes needed to understand health and community impacts. Frequency band distribution is one of these other metrics. In this presentation, the case of commercial gas and battery electric leaf blowers (GLB, BLB) will be discussed. GLBs expose workers and the public to harmful noise levels. Their frequent and prolonged use in many communities is a health and public health problem especially for workers, children, seniors, and those with certain preexisting conditions. Recent studies show a strong low frequency component in GLB sound that enables harmful noise levels to travel longer distances and to more readily penetrate buildings compared with BLB sound. In a controlled head-to-head study of a GLB and BLB (both commercial grade; both rated at 65 dB at 15 meters), GLB outdoor sound was much greater at distances exceeding 122 meters from the source and indoors compared with BLB sound. Differences in frequency spectra have important implications for auditory and non-auditory health and should be used to inform public policy.

28939 - noise map paradox and commuting time noise exposures

8. Noise exposure assessment in health effect studies
Keywords: commuting time, noise map, nose level zoning
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Adverse health effect is one of the focuses of environmental noise problems. If some kind of noises were so hazardous, why do we not count other severe situations? Many epidemiological approaches have been performed on their health effects. In these studies, the noise exposure levels were mainly estimated from dwelling area in noise maps. Hence this type of estimation is invalid for the people who spend many hours out of their areas. Especially the exposure during commuting time is so heavy. As many data show, the level in the subway or vehicles excess 80dBA. Concerning Tokyo area, two hours of commuting time are not rare among workers. Here we compared the whole day noise exposure levels between two typical worker models. One was a short time commuter dwelling in a noisy city area and the other was a long-time commuter in a quiet suburban area. As a result, the average noise level often showed lower in the former than in the later. Without lifestyle information the magnitude relation among noise exposure levels based on simple noise zoning can be reversed.

33372 - Environmental exposure to noise and risk of cardiometabolic diseases through devices connected in the E3N-E4N cohort in two French regions (2000-2018)

8. Noise exposure assessment in health effect studies
Keywords: Noise Exposure, E-health devices, Epidemiology, Cardio-metabolic diseases, Cohort
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Noise has consequences on health and well-being. According to the WHO's Environmental Noise Guidelines in 2018, health issues due to noise are related to sleep disturbance, noise annoyance and cardiovascular disease. But a few studies have investigated diabetes.

In 2014, 3.5 million French people suffered from diabetes and 12.2 million from hypertension. Lifestyle alone does not fully explain the occurrence of these pathologies. It is therefore necessary to examine the role of "non-traditional" risk factors such as noise exposure. Indeed, noise generates stress that can disrupt the cardio-metabolic functioning.

The BROUHAHA project will study the effect of transportation noise exposure on the risk of cardio-metabolic disease (type 2 diabetes, hypertension and cardiovascular disease) in 35,000 women of the E3N cohort between 2000 and 2018.

The second part of BROUHAHA will observe the effects of short-term noise exposure on intermediate cardio-metabolic markers (blood pressure, blood sugar, heart rate) in 120 participants of the E4N cohort residing in two French regions. Individual noise and physiological measurements will be performed by e-health devices for one week. The project was launched in January 2021.

33931 - Development of a high-frequency and ultrasound personal noise exposure meter for identification of sufficient sound rating quantities

8. Noise exposure assessment in health effect studies
Keywords: high-frequency sound, ultrasound, noise, workplace measurement
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Many workplaces are exposed to high-frequency audible noise and/or ultrasonic noise with dominant contributions from frequencies between 10 and 40 kHz.

Apart from hearing loss, that may occur at high daily noise exposure levels, non-auditory health effects can arise at far lower sound pressure levels. Especially effects caused by tonal noise, high-frequency noise and ultrasound are not understood in depth.

Therefore, measurement quantities reflecting the noise exposure and possible non-auditory health effects on workers are also lacking. Such quantities should be easily and reproducibly determined during workplace noise measurements.

To improve this situation, investigations involving comprehensive noise measurements at workplaces combined with questionnaires aiming at capturing mental stress and strain of workers are planned to be carried out. High-precision sound level meters are too heavy to be carried around all day and cannot capture ultrasonic noise. Moreover, common personal noise exposure meters only cover frequencies up to 10 kHz. So, a new measurement device is needed as basis to perform the above-mentioned investigations.

We show first results of the development process of a personal high-frequency and ultrasound noise exposure meter.

34009 - Application of a night-tine noise index based on neurophysiological theory to the evaluation of the cardiovascular effects of noise around Kadena airfield

8. Noise exposure assessment in health effect studies
Keywords: aircraft noise, epidemiological study, hypertension, night-time noise index
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Night-time noise exposure may cause health effects such as environmental sleep disorder, hypertension, ischaemic heart disease, stroke, and diabetes. Night equivalent level (L_{night}) has been widely used to evaluate the health effects; however, it is selected just for practical reasons. Greater effects would also be caused due to a large number of noise events, which is not fully considered in most existing studies. The present study aimed to evaluate the health effects of night-time noise index using an alternative noise index, L_{60}, instead of L_{night}. L_{60} is derived from neurophysiological theory and enables evaluation of the effects of both short- and long-term noise exposure. We analysed sound-level statistics including L_{60}, L_{night}, and the number of noise events above 60 dB around Kadena airfield. Then we conducted multivariate regression analysis to obtain an equation to estimate L_{60} from the existing noise indices. Finally, we investigated the relationship between the estimated L_{60} and the prevalence of hypertension, using the results of an existing epidemiological survey around Kadena military airfield.

34024 - Noise indicators related to noise exposure and non-auditory health effects in children. A systematic literature review.

8. Noise exposure assessment in health effect studies
Keywords: noise indicators, noise exposure, non-auditory, health effects, children
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Objective noise indicators have been used for the characterization of urban and non-urban sound environments. Studies have identified possible correlations between noise exposure, and therefore to noise indictors, with health-related effects. A higher amount of research has been provided with respect to adults in contrast to children group, indicating a sensitive group. Children-based studies related to noise-induced auditory health effects, overcomes the non-auditory health effects studies. In most of the studies related to non-auditory health effects, traditional/energy-based noise indicators have been used. This systematic literature review tries to shed a light on the noise indicators correlated to noise exposure and non-auditory health effects (i.e., psychophysiological, cognitive, psychological, sleep and other aspects) in children. By identifying the noise indicators related to non-auditory health effects in children, it is possible the improvement of the current used noise indicators as well as the development of new noise indicators, using technological techniques such as machine learning-based indicators.

9. Special topics related to noise effects

28612 - Noise and Health – a new beginning of an international scientific journal

9. Special topics related to noise effects
Keywords: noise, health, publishing, science
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When a Serbian scientist was reading a brand new international journal named Noise and Health in the heat of Sydney at the 7th ICBEN Congress in November 1998, he couldn't imagine in his sweetest dreams that the reader would become the journal's Editor-in-Chief. The editorial duo Belojevic-Prasher is entering the third decade of the journal with a new Editorial Board, a mixture of scientific experience and young enthusiasm from the East and West and North and South. The standards of the journal are raised. Open-access with extremely low publishing fees will keep the entrance for the manuscripts widely open. However, the publishing exit will be narrowed. The reviewing process will be shortened to two weeks based on a paradigm that an author's time is inviolable. The double-blind reviewing process will ensure an objective assessment of the quality of papers. The relationship between ICBEN and Noise and Health has never been nor will be official, but will be essential. In this paper, we present the past, present, and future of the journal.

28874 - Toys' noise measurement - do we need alternative approach?

9. Special topics related to noise effects
Keywords: psychoacoustics, noise, toys, hearing, measurements
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As the problem of sound generated by the toys seems to remain underestimated, the aim of the research was to discuss how modifications of the standardised set-up of toys' noise measurement influence the results and whether the procedures and markings of toys should be improved. Basing on over 180 responses in the on-line questionnaire 3 toys types were chosen and then, measured in an anechoic chamber with sound level meter and SQuadriga in two setups - first, defined by the norm and second - reflecting real use.

Sound level values didn't exceed limits established in the norms. However, discrepancies obtained during measurements performed in the way specified by suitable standards and conducted in real-life terms were observed.

To provide comprehensive information on sound levels and acoustic characteristics, of toys' sound, phantoms or dummy heads, as well as environment settings describing actual object's use and time spent on playing, should be taken into account.

33066 - Metronova – research on physical and perceived noise and vibrations from Oslo's metro trains

9. Special topics related to noise effects
Keywords: noise, vibration, annoyance, qualitative, objective
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The Metronova project is a research project about physical and perceived noise from Oslo's metro trains based on consultancy commissions and student assignments. Measurements of noise and vibrations from Oslo's metros since 2007 and an environmental monitoring program with yearly measurements since 2016 form the backbone of the project. In 2014 a survey questionnaire about perceived vibrations were added. In 2019 a study including qualitative research interviews in the homes of neighbors of the metro about their perception of noise and vibrations was added. In the same year we also added laboratory tests of the reactions of several test persons to field recorded sound from metro trains.

New ways of studying noise and its effects are added continuously. It started with traditional measurements of 1/3-octave and A-weighted noise. Since then we have added vibration measurements, survey questionnaires, qualitative research interviews, psychoacoustic parameters and finally laboratory listening tests correlated with A-weighted noise and psychoacoustic parameters.

It would seem that rich data from the project give a good insight towards an understanding of reactions to noise from metro trains.

34019 - Mitigating health risks due to road traffic noise by the transition to electric vehicles

9. Special topics related to noise effects
Keywords: Road traffic noise, electric vehicles, health risks, risk mitigation
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Recent social changes in achieving a low-carbon society could transform the acoustic environment, i.e. the transition from conventional internal combustion engine vehicles (ICEVs) to electric vehicles (EVs). However, health risk reduction by the transition remains unclear. In this study, the potential of health risk reduction by the transition to EVs in small and large urban areas in Sapporo City, Japan with actual traffic conditions was explored. This is the first large-scale estimation of risk reduction by introducing EVs. Sound level calculations and health risk estimations were performed for the current situation with ICEVs and after the transition to EVs. The emission and propagation of noise were calculated according to the CNOSSOS-EU noise emission model, and the exposure–response functions provided by the WHO Regional Office for Europe were employed to estimate the health risk reduction. Several tens of percent of health risk reduction were estimated with the shift to EVs, which showed the effectiveness of the transition. Wide spreading of EVs could be a transformative means in mitigating the health risks due to road traffic noise.

10. Low frequency noise and vibration

27555 - Low-frequencies tones within a total sound measurement. How to deal with it by means of outliers Criterion in order to eliminate the unwanted sound

10. Low frequency noise and vibration
Keywords: Low-frequency, infrasound, assessment, statistics,
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Any noise measurement is done immerse into a complex acoustical environment, being the resulting file the total sound. Even if there was only one noise source under investigation (the specific sound), wind, vehicles passing-by and others, all together will constitute the total sound. Acoustic emissions from industrial facilities have high energy level in low-frequency and infrasound, which are difficult to isolate them for further analysis. One recommended method in ISO 1996-2:2017, lay about using a statistical method to exclude unwanted sound. The authors have developed an algorithm to discriminate the specific sound from the total sound file (not frequency filtering), by means of an outliers distinct method. This Paper discuss of using that algorithm in urban zones, not just for industrial areas but also for HVAC systems, pumps, compressor, etc., in residential zones. After getting the specific sound file, it is easier to detect and identify the low-frequency tones, by using the total sound time-history file, and as a result, the right infrasound energy from the facilities under investigation.

28989 - Study on methods for localization of low frequency sounds

10. Low frequency noise and vibration
Keywords: low frequency sound, infrasound, localization, sound source, microphone array
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We examined how to locate the low frequency sound sources under 50 Hz. It is difficult to determine these low frequency sound source locations easily because low frequency sound is hard for human beings to hear. Therefore, we examined a method to locate the sound source by using microphone array to surround sound sources. First, we conducted field experiments using a loud speaker to verify this method. As a result, it was confirmed that the position of a loud speaker within a range of several tens of meters can be estimated with an accuracy of about 2 m by using eight microphones. Next, we tried to estimate locations of the actual sound sources such as elephants speaking, electric water heater sounds and car idling sounds. As a result, we confirmed the usefulness of this method.

29018 - Low Frequency Noise – Experiences from a Low Frequency Noise sensitive population

10. Low frequency noise and vibration
Keywords: Noise, Low-frequency Noise, LFN, Health
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Until now, Low-frequency noise (LFN) is hardly recognized as an environmental stressor, and its consequences on daily functioning have been rarely investigated. LFN is predominantly produced by human-made sources, and due to the increasing industrialization, these sources and accordingly, the number of LFN complaints is steadily rising. Although the majority of the general population does not consciously perceive LFN, an estimated 2% of the Dutch adult population experiences severe annoyance from its exposure. Individuals sensitive to perceiving LFN in their everyday life report various physical complaints and particularly psychological complaints, such as sleeping difficulties, fatigue and stress, and cognitive difficulties such as difficulties in concentration or so-called executive functions. Yet, it is unclear why some people are more sensitive to and suffer more from LFN than others, and a comprehensive (neuro)psychological investigation in this population is still lacking. During an exploratory study, the demographic and personal characteristics of LFN-sensitive individuals, the perceptions of LFN-sensitive individuals and the reported physical, psychological, and social health-related symptoms and restrictions in daily living were investigated.

34026 - The health effects of the exposure to vibration due to trains: a longitudinal study

10. Low frequency noise and vibration
Keywords: vibration, rail traffic, noise, health effects
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Of the 4927 participants in a survey held in 2013, 1349 participated in a repeated measurement in 2019. These participants were 16 years and older, living in the Netherlands within 300 meters from a railroad track. 40 % of these residents experienced severe annoyance from vibrations and 30 % experienced severe sleep disturbance caused by trains. However, only for passenger trains we see an increase in the percentage highly annoyed and sleep disturbed, while the figures for freight trains are stable over time. Neither the change in estimated levels of vibration nor changes in attitude and expectations explain these findings. Exposure to vibrations was estimated by the newly developed OURS model. This presentation will present the first findings.

11. Health impact assessment/Burden of Disease

34040 - Digital technologies for HIA: smart method for noise impact assessment

11. Health impact assessment/Burden of Disease
Keywords: residential noise exposure, road traffic noise
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Strategic noise maps provide valuable information on environmental noise levels for HIA. Using GIS technologies and combined with spatial population census data strategic noise maps were applied for residential exposure evaluation. Exposure to traffic noise is considerable in agglomerations and has been associated with health effects. It is recognized that road traffic noise is dominant. The study is based on the results of strategic noise mapping in Kaunas agglomeration (289 thousands inhabitants), Lithuania. Residential exposure to road traffic noise evaluated by L_{den} (day-evening-night level) and L_{night} noise indicators was analysed. Indicators L_{den} and L_{night} were used for evaluation of annoyance and sleep disturbance. ArcGIS programme was applied for the analysis of noise and population exposed. The estimated number of inhabitants that are exposed to the values of L_{den} > 65 dBA and L_{night} > 55 dBA were 253 and 614 hundreds, respectively. Following building and spatial based estimations, existing assessment models for the highly-annoyed (%HA) and highly-sleep-disturbed (%HSD) were adopted. The study provides further insight into the scale of road traffic noise exposure on population and demonstrates smart method for HIA.

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