experimental models, attempts to detect occupational NIHL, or clinical case-study descriptions of emissions in patients with NIHL symptoms. Given that the initial pathology underlying NIHL entails damage to, or destruction of, the organ of Corti's outer hair cells (OHCs), it was expected that OAEs, which are generated by OHCs, would faithfully describe the behavioral audiogram in humans and/or the underlying cochlear pathology in experimental models. On a population basis, this expectation was usually born out. However, in general, using OAE tests, it is difficult to predict either the pattern of behavioral hearing or the underlying cochlear pathology on an individual basis. Among the reasons for explaining disagreements between the various response measures is the field's present knowledge about distinct and complex sources that contribute to the generation of OAEs. Nevertheless, current research findings will be discussed that hold promise for the ability of future OAE tests to detect early NIHL, and to accurately predict its associated hearing pattern and/or cochlear pathology.

597 Tinnitus and Hyperacusis: Involvement of Auditory and Nonauditory Structures

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Background: Exposure to intense noise or ototoxic drugs not only results in hearing loss, but often leads to tinnitus and hyperacusis. The aberrant neural activity responsible for tinnitus and hyperacusis was believed to originate within the classical auditory pathway; however, more recent data suggest the potential involvement of nonauditory structures in the CNS. Here we review some of the neurophysiological changes seen in the cochlea and CNS when rats are treated with a dose of salicylate that induces tinnitus and hyperacusis-like behavior.
Methods: Operant conditioning techniques and the startle reflex were used to identify doses of salicylate that produce tinnitus and hyperacusis-like behavior in rats. Afterwards, we characterized the aberrant patterns of neural activity in the cochlea, auditory pathway and nonauditory sites.
Results: High-dose salicylate (i.p.) caused a frequency-dependent loss in DPOAE and reductions in CAP amplitude; losses were greatest at low and high frequencies and least in the mid-frequencies (10-20 kHz). Salicylate induced threshold shifts in the central auditory pathway that mirrored the cochlear losses, but did not significantly alter spontaneous activity. Despite the threshold shifts and reduced cochlear output (hypoactivity), sound-evoked responses in auditory cortex, medial geniculate, amygdala, striatum and hippocampus were larger than normal at suprathreshold intensities (hyperactivity). Moreover, many low-CF and high-CF neurons in auditory cortex and amygdala shifted their CF into the mid-frequencies. These up-shifts and down-shifts resulted in an over-representation of mid-CF neurons; the expanded mid-CF region lies near the tinnitus pitch induced by salicylate. To eliminate peripheral drug effects, salicylate was applied to the amygdala or auditory cortex, while recording from the auditory cortex. In both cases, salicylate increased sound-evoked activity in auditory cortex at suprathreshold levels, but did not alter threshold.
Conclusion: Salicylate exerts potent effects on the cochlea, central auditory pathway and non-auditory regions of the CNS. Salicylate-induced thresholds shifts originate in the cochlea whereas sound-evoked hyperactivity, a possible correlate of hyperacusis, likely originates at auditory and nonauditory sites in the CNS. The salicylate-induced tonotopic shifts seen in auditory cortex, which may underlie tinnitus, likely results from both peripheral and central changes.
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598 Translating Data Into Knowledge and Action: Challenges in Evidence-Based Hearing Loss Prevention

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Background: Evidence-based practices seek to ensure that the best available scientific evidence is used in clinical decision making. Such approach requires assessing all scientific evidence available on the risks and benefits of interventions and diagnostic procedures. Evidence quality is assessed based on the source type (from meta-analyses and systematic reviews of randomized clinical trials as high-quality sources, down to conventional wisdom as low-quality ones), currency, statistical validity, clinical relevance, and peer-review acceptance. The 2009 American Recovery and Reinvestment Act included a provision for federal funding to investigate how different interventions compare to each other. The Act called on the Institute of Medicine to recommend comparative effectiveness research priority topics. Their recommendations are in the report Initial National Priorities for Comparative Effectiveness Research (http://www.nap.edu/catalog/12648.html). The need for research on hearing loss interventions was placed in the highest priority group. This recommendation underscores the human and societal costs of the condition. The risk of hearing impairment increases with age and is exacerbated by exposure to noise, particularly at work. This risk can be minimized by reducing noise levels to 85 dB(A) or less. Many countries have mandated hearing loss prevention programs when noise exposures cannot be reduced to this level. However, the continuing high rate of noise-induced hearing loss raises concerns on the effectiveness of these programs.
Methods: Recent Cochrane Reviews investigated various initiatives and mechanisms (e.g., legislation, proper hearing protector usage, etc.) to determine which work best to either promote the use of hearing protections, and/or reduce noise exposure or hearing loss among workers.
Results: Results from intervention effectiveness studies on hearing loss prevention do not provide evidence to support current practices. There is consensus in the literature that some interventions improve the use of hearing protection devices compared to non-intervention; there is low quality

evidence that legislation can reduce noise levels in workplaces, and contradictory evidence that prevention programs are effective in the long-term. Most reported interventions focus on the use of hearing protectors, and effectiveness depends on the quality of the implementation of prevention programs. Substantial noise control can be achieved in the workplace, with no evidence of this practice in the literature.
Conclusions: Better and large scale implementation of technical interventions and evaluation of their long-term effects are necessary to identify the most effective strategies for reducing occupational hearing loss.

599 Frequency Discrimination Through Phase Locking

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Background
Humans can discriminate frequencies that are only about 0.2% apart when the frequencies are below 4 kHz. For comparison, a semitone in Western music represents a frequency step of about 6%. Frequencies higher than 4 kHz are increasingly hard to differentiate; as an example, the frequency-discrimination threshold at 6 kHz is about 1.5%. This contrasts with tuning curves of auditory-nerve fibers, which are considerably sharper for high-frequency than for low-frequency fibers. The enhanced frequency discrimination below 4 kHz has been hypothesized to involve the phase locking of specialized neurons in the auditory brain stem that fire at a preferred phase of stimulation.

Methods
We performed psychoacoustic experiments to directly measure the effect of phase locking on frequency discrimination. We generated tones based on a single frequency but in which a random phase change occurred every few cycles. These tones were presented to subjects who performed a frequency-discrimination task. In a theoretical work we then investigated how the frequency information contained in phase locking might be read out in neural networks. We specifically used numerical and analytical techniques to study a class of random neural networks in which signal propagation from one neuron to another induces a time delay and in which the neurons perform coincidence detection.

Results
Our psychophysical experiments showed that random phase changes systematically impede our ability to discriminate frequencies. The frequency resolution in the presence of phase changes is bad as that for short tones whose duration is limited to the time between two subsequent phase changes. We found that the neural networks can perform sharp frequency discrimination when stimulated with phase-locked input: different frequencies induce different neural activity patterns. The frequency resolution achieved by this means depends on the noise in the phase locking and can, for realistic values, reach the minute frequency differences of around 0.2% that have been measured in humans.

Conclusion
Our psychophysical experiments provide direct evidence that phase locking is employed for frequency discrimination. Our theoretical study on a class of random neural networks with temporal delay and coincidence detection offers a framework for how the brain can read out the temporal information contained in phase locking.

600 Spectral Ripple Discrimination in Infants: Effect of Ripple Depth and Envelope Phase Randomization

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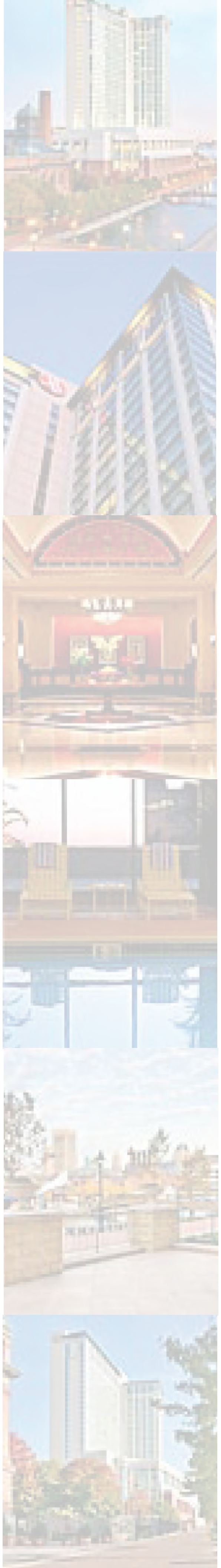
Background
Spectral ripple discrimination (SRD) measures sensitivity to spectral change across a broad frequency range. In infants, SRD might be affected by developmental differences in non-spectral factors, such as intensity resolution, attention, or listening strategy. In Experiment 1, we measured infants' and adults' SRD thresholds at various ripple depths to determine the spectral modulation transfer function (SMTF). It was predicted that SMTF height would be lower in infants due to immature intensity resolution and/or attention, while SMTF slopes would be equivalent between age groups due to mature spectral resolution. In Experiment 2, two stimulus conditions were used to determine whether either age group relied on within channel listening strategies. It was predicted that availability of within-channel intensity cues would not affect SRD in either age group.

Methods
Participants were normal-hearing 7-month-olds and young adults. Stimuli were broad-band noise bursts filtered by a full-wave rectified sinusoidal spectral envelope with logarithmically-spaced peaks. The Observer-based Psychoacoustical Procedure was used to determine the highest ripple density at which a participant could detect a 90º phase shift in the spectral envelope. In experiment 1, ripple depth was varied between subjects and SRD threshold in ripple density was assessed. In experiment 2, two stimulus conditions were created based on the starting phase of the spectral envelope: Constant (starting phase was always 0º) and Randomized (starting phase varied from 0º to 270º). Stimulus condition was varied between subjects and SRD threshold assessed.

Results
In experiment 1 the effect of ripple depth and age group on SRD threshold was measured using ANOVA. Main effects of age-group (adults with better thresholds than infants)



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