SLEEP DISTURBANCE DUE TO TRANSPORTATION NOISE

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Introduction Although the most common metric for assessing the impacts of community noise, the Day-Night Average Sound Level (DNL), already contains a 10-dB penalty for nighttime noises, there are circumstances where a separate analysis of the impacts of nighttime transportation noises might be warranted. There are, however, different definitions of sleep disturbance and different ways to measure it, different exposure metrics that can be used, and consistent differences in the results of laboratory versus field studies. Pearsons et al. [1] previously compiled a comprehensive database representing over 25 years of both laboratory and field research on noise induced sleep disturbance. This database was the basis for an interim curve recommended by Finegold et al. [2] to predict the percent of exposed individuals awakened as a function of indoor A-weighted Sound Exposure Level (ASEL). This curve was adopted by the U.S. Federal Interagency Committee on Noise (FICON) [3] as an "interim" sleep disturbance exposure-response relationship with the caveat that additional research was needed. Since the publication of the FICON report, a series of additional field studies have been conducted in the U.S. to further investigate noise induced sleep disturbance from transportation noise sources, primarily aircraft noise, in various residential settings.

Method and Results A database of awakenings as a function of single event sound exposure levels was developed from the field study data presented in Pearsons, et al. [1] and Fidell et al. [4]. The number of respondents from a particular study awakened at a given noise level was converted to a percent of awakenings defined here as "(observed awakenings at a given noise level/total number of noise events at that noise level) x 100%". Each resulting data point was given equal weighting. The noise levels within individual respondent's sleeping quarters were estimated and converted to a common ASEL metric. The resulting data set consisted of 100 data points representing eight different field studies. A best fitting function though the data relating the percent of study participants awakened as a function of indoor ASEL was then generated. Figure 1 identifies the data points according to the study from which they were derived and the resulting prediction curve.

Conclusion Accurate prediction of nighttime sleep disturbance is rapidly becoming very important in the noise policy arena, where decisions are being made involving quite large sums of money for the insulation of homes and other noise abatement programs, based on the results of environmental impact analyses. Although many options are available for alternative interpretations of the published sleep disturbance data on issues such as which of the various definitions of sleep disturbance to use, using laboratory versus field data, and which noise exposure metric to use, the current analysis has several attributes that make it particularly attractive. Indoor measurements are recommended for sleep disturbance field research and related policy-making activities, since these are the exposure levels that actually reach people in their homes and because it would be impossible to develop one single outdoor-indoor transfer function that would be valid to apply everywhere. In addition, there has been a steadily growing acceptance of the desirability of using field study data, rather than laboratory data, for developing a sleep disturbance dose-response relationship, because the laboratory data seems to consistently overpredict the levels of sleep disturbance actually

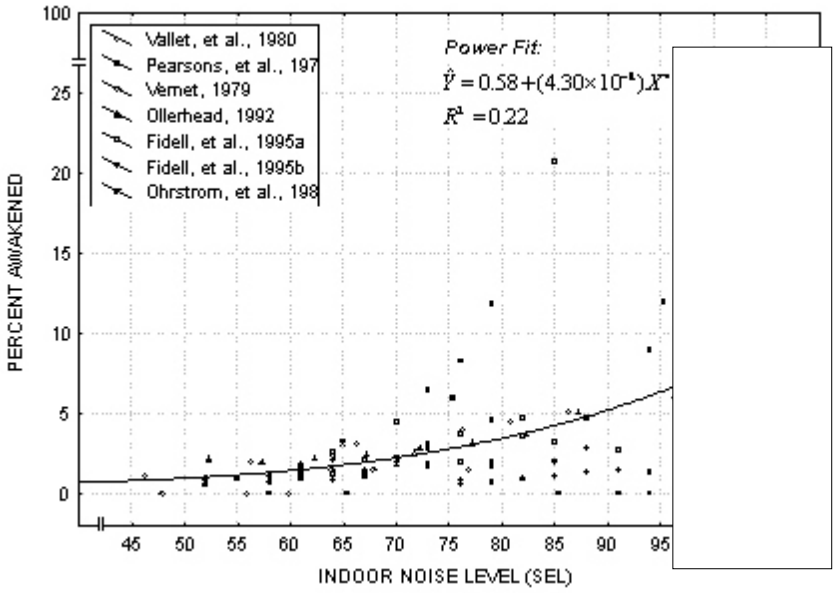

Figure 1: Recommended curve with data points identified by original source study

experienced in people's homes during their normal daily lives. Concerning the face validity of the proposed curve, examination of the data points in Figure 1 shows that a straight line data fit would not seem appropriate, although the latter approach has been recommended by others [cf., 4, 5, 6]. There seems to be a gradually increasing (exponential) slope in the data that must be accounted for in the choice of the fitting function. A more thorough description of the study briefly described here was presented previously by Finegold & Elias [7].

References

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* This project was initiated while the authors worked for the U.S. Air Force Research Laboratory (AFRL) at Wright-Patterson AFB, OH, USA. The views expressed are not necessarily endorsed by this organization.