The Effects of Transportation Noise on People – The Current State of Research

Jim Cowan, URS Corporation
Manchester, NH

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Topics

• Why?
• Documented physiological effects
• Documented psychological effects
• Public concerns
Why?

• This should be the basis for our work
  – Sometimes we lose sight of that

• Only addressing negative effects here
  – Yes, there are positive effects associated with sound
Documented Physiological Effects

• Hearing loss
  – well-established
  – not an issue for the public, mainly occupational

• Cardiovascular diseases

• Low frequency/infrasound effects

• Confounding factors (for all effects)
  – demographics, lifestyle, personality type, opinion about source(s), fear, visual, personal sensitivities
Noise-induced hearing loss

~100 dBA TWA occupational exposure

Source: Taylor, et. al. 1965
Cardiovascular Disease Research

• Hypertension (blood pressure)
  – studies mainly for air and traffic
  – HYENA Study (6 countries/airports, 2005-2006)
    • Hypertension and exposure to noise near airports
    • 45-70 ages, various average descriptors

• Ischaemic (blood supply) heart diseases
  – studies mainly for traffic
  – myocardial infarction (heart attack)
    • based on odds ratio
  – arteriosclerosis
  – angina
  – stroke (>60 dBA $L_{den}$, >64.5 age)
MI dose-response relationship
(traffic noise)

Source: Babisch 2008
Low Frequency/Infrasound Research

- LFN (20-200 Hz) vs. infrasound (<20 Hz)
  - perception thresholds very high
  - Is auditory perception required?

Sources: Watanabe and Møller 1991, ANSI S1.42-2001(R2011)
LFN/Infrasound effects

• Vestibular effects
  – at high levels (>155 dB @20 Hz, 135 dB @1000Hz)
  – nystagmus – at high levels (>110 dB >60 s@20 Hz, >140 dB for infrasound, shorter durations)
  – Visceral Vibratory Vestibular Disturbance (VVVD)

• Potential non-audible effects
  – vibroacoustic disease (VAD) - >90 dB, <500 Hz
  – respiratory (chest resonance @40-80 Hz, >130 dB), physical damage >185 dB

• In most cases, these effects are not relevant to transportation noise
Documented Psychological Effects

- Annoyance
- Sleep disturbance
- Stress (and stress-related illness)
- Learning disabilities
Annoyance Research

• Community reaction ratings (EPA 1974, FICON 1992)

<table>
<thead>
<tr>
<th>$L_{dn}$</th>
<th>Community Reaction</th>
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<tbody>
<tr>
<td>≥75</td>
<td>Very severe</td>
</tr>
<tr>
<td>70</td>
<td>Severe</td>
</tr>
<tr>
<td>65</td>
<td>Significant</td>
</tr>
<tr>
<td>60</td>
<td>Moderate to slight</td>
</tr>
<tr>
<td>≤55</td>
<td></td>
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• %HA dose-response curves
  – Schultz (1978) through Miedema & Oudshoorn (2001), FAA study currently being performed
Dose-response curves

Source: Miedema and Oudshoorn 2001
Sleep Disturbance Research

• Must distinguish between internal (e.g., anxiety) and external (e.g., noise) causes
• % awakenings curves
• % sleep disturbed curves
Awakenings dose-response curves

Source: ANSI 12.9-2008
Sleep disturbed dose-response

% highly sleep disturbed

L_{night} (dBA)

Source: Miedema et. al. 2002
Stress Effects Research

• Endocrine system imbalance
  – Cortisol, other hormones
• Mental health
• Aggression/anxiety
Learning Disabilities Research

- Reading comprehension
- Memory
- Standardized tests
Cognitive effects

Source: WHO 2011
Public Concerns

• All of the above
• New(?) concern is LFN/infrasound
  – Potential health effects
  – dBA not appropriate for LFN/infrasound rating
• Key is referencing credible research
  – Brown noise vs. brown note
  – Sensitivities are variable
References


