IEQ and Productivity: Is there a link?

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Hedge, A. (2001) “Indoor environmental quality and productivity”, 1st Environmental Systems Symposium at Syracuse, Syracuse University, October 29, 2001.

What is productivity?

- Individual measures:
  - Task Performance (time, accuracy, quantity, quality)
  - Self-reports
- Group measures:
  - Work performance (Group output)
  - Supervisor/Peer reports
- Organizational measures:
  - Performance appraisal
  - Corporate output
  - Corporate profits
- Time base?
  - minute, hour, day, week, month, quarter, year, life

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What is productivity?

- No unitary definition of productivity
- No universal time base
- Productivity measured in multiple ways
- Productivity is an operational concept
- Productivity implies some aspect of human performance

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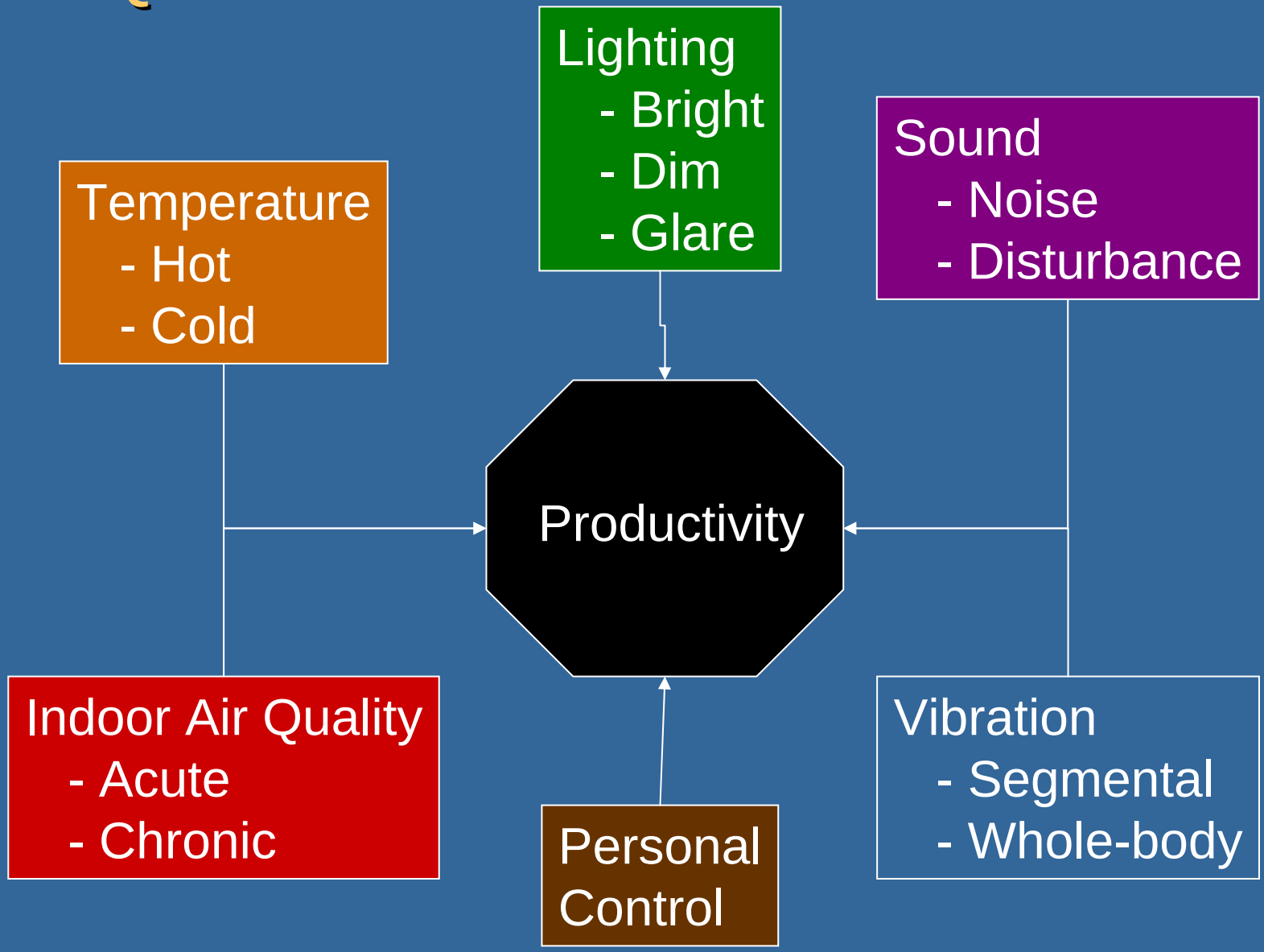
IEQ factors and Human Performance



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IAQ Effects on Productivity
(Fisk & Rosenfeld, 1997, Indoor Air, 7, 158)

- Infectious disease transmission
- Allergies & asthma
- Sick Building Syndrome
- Direct effects
- Intervention studies

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IAQ Effects on Productivity

- Increased risk of infectious respiratory disease transmission in:
  - air-conditioned army barracks (Brundage et al., 1988)
  - Gulf war troops in air-conditioned buildings (Richards et al., 1993)
  - Shared offices (Jaakkola & Heinonen, 1993)
  - Smaller, poorly ventilated jail cells (Hoge et al., 1994)
- Fear of bioterrorism (e.g. anthrax)

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IAQ Effects on Productivity

- Effects of allergens and asthma. Studies of:
  - Moisture and building materials
  - Bacteria (gram negative - endotoxin)
  - Fungi
  - Allergens
    - Dust mites
    - Cockroach
    - Pets (cats, dogs etc.)
- Indoor conditions provoke responses in susceptible/sensitive people.

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IAQ Effects on Productivity

- Studies of direct performance effects of numerous pollutants:
  - Carbon monoxide (e.g. vigilance studies)
  - Carbon dioxide, NOx, Ozone
  - Volatile organic compounds (individual and mixtures)
  - Particulates
  - Odors/Fragrances
  - Negative air ionization (controversial)
- Usually short-term laboratory/chamber studies.
- Performance decrements occur at certain levels of specific indoor pollutants.

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IAQ Effects on Productivity

- Studies of sick building syndrome (self-reported symptoms of malaise) show decreases in self-reported productivity with increases in sick-building syndrome reports.
- Typically field studies and correlation analyses.

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IAQ Effects on Productivity

- Intervention studies of improvements to ventilation show increases in self-reported and measured productivity:
  - Supplemental, furniture-integrated breathing-zone air filtration (Hedge et al., 1993)
  - Personal environment systems (Kroner et al., 1993)
  - Conflicting effects of changing ventilation rate (e.g. Jakkola et al., 1995)

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IEQ Effects on Productivity

- Scattered studies that mostly show evidence of an association between indoor environment conditions and some measure of performance.
- Future research issues:
  - Laboratory vs. field studies
  - Single vs. multiple contaminants/conditions
  - Surveys vs. interventions
  - Short-term vs. longer-term
  - Single exposure vs. multiple exposure
  - Time-lagged effects
  - Acute vs. chronic health effects

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