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FEDERAL INTERAGENCY COMMITTEE ON AVIATION NOISE

Relation Between Aircraft Noise Reduction in Schools and Standardized Test Scores:

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Overview

- **Background**
- **Study overview:**
  - Research questions
  - Standardized test scores
  - Airports and schools
- **Analysis method**
  - Time period for computed noise exposure
  - Some computation details, plus resulting noise metrics
  - Demographic “control”
  - Some regression mathematics
- **Initial results**
- **Recommendations for any follow-up studies**

Background

- **Past research:**
  - Aircraft noise can interfere with classroom learning.
  - Strongest effect is upon “reading,” say majority of studies.
- **Feb 2000: FICAN forum**
- **Sep 2000: FICAN statement of position:**
  - Need a FICAN-funded study (*this current study*), based on existing publicly-available data.

Study Overview:
Research Questions

- **Is aircraft noise reduction within classrooms related to test-score improvement, after controlling for demographics?**
- **Does this relationship vary by:**
  - Age group (high, middle and elementary school)
  - Student group (IEP and non-IEP)
  - Test type (verbal and math/science)

Study Overview: Standardized Test Scores

- **Test scores for state-standardized tests**
- **These test scores are increasingly important in the U.S., because they help determine:**
  - Student class credit
  - Student grade advancement
  - Student graduation
  - School funding
  - School accreditation.

Study Overview: Airports and Schools

- **Three airports:**
  - In states with publicly available test scores (electronic format only the last 10 years)
  - Reduction in aircraft noise, due to:
    - Airport closure, or
    - School sound-insulation program
- **Thirty-two nearby public schools:**
  - Excluded non-public schools, because they are not required to give state-standardized test to all their students.
- **No guarantee that these airports/schools are representative.**
  - So results here should not be used nationally without subsequent studies of many additional airports and schools.

Analysis Method: Time Period for Computed Noise Exposure

- **Compared to studies using pre-computed noise contours, this study:**
  - Used just school months, rather than full year
  - Used just school hours, rather than 24 hours
  - Converted to indoors, to account for school/window structure
- **In addition, this study:**
  - Used full school year to determine noise exposure, rather than just sampled measurement periods.

Analysis Method: Some Computation Details

- **Year-by-year air traffic**
  - Combination of Part 150 studies, Official Airline Guide (OAG), aircraft inventories by air carrier
- **Outdoor noise: INM 6.1**
  - SEL and L_{Amax} for each aircraft flyover
- **Conversion to indoor noise**
  - INM aircraft spectra
  - Construction details—main school and portable classrooms

Analysis Method: Resulting Noise Metrics

- **For school year, school hours, inside classrooms:**
  - School-day L_{Aeq}
  - Percent of time L_A > 40 dB**
  - Number of events with L_{Amax} > 40 dB
  - Number of events disrupting speech:
    - Speech Intelligibility Index (SII) < 0.98

**40 dB was chosen to conform to recent ANSI standard.

Analysis Method: Demographic "Control"

- **Primary method:**
  - "Noise-reduction" group
    - Each school, before-to-after the year of noise reduction
  - "Control" group
    - Same schools, but for all the years prior to noise reduction
  - Same schools means same demographics.
- **Secondary method:**
  - Also controlled for demographics in the regression analysis.
    - Avoids associating test-score improvement with noise reduction, if test-score improvement is more strongly associated with demographics.

Analysis Method: Some Regression Mathematics

- **Multi-level regression: Needed because data are "nested"—schools sampled first, then test years, then tests scores.**
- **Single-year change in test scores, related to change in noise:**

$$\begin{aligned}\text{change in test score} = C_1 &+ C_2\left(\text{change in noise}\right) + C_3\left(\text{prior test score}\right) + C_4\left(\text{prior noise dose}\right) \\ &+ \text{terms for demographics} \\ &+ \text{terms denoting various subgroups} \\ &+ \text{"interaction" terms with } \left(\text{change in noise}\right).\end{aligned}$$

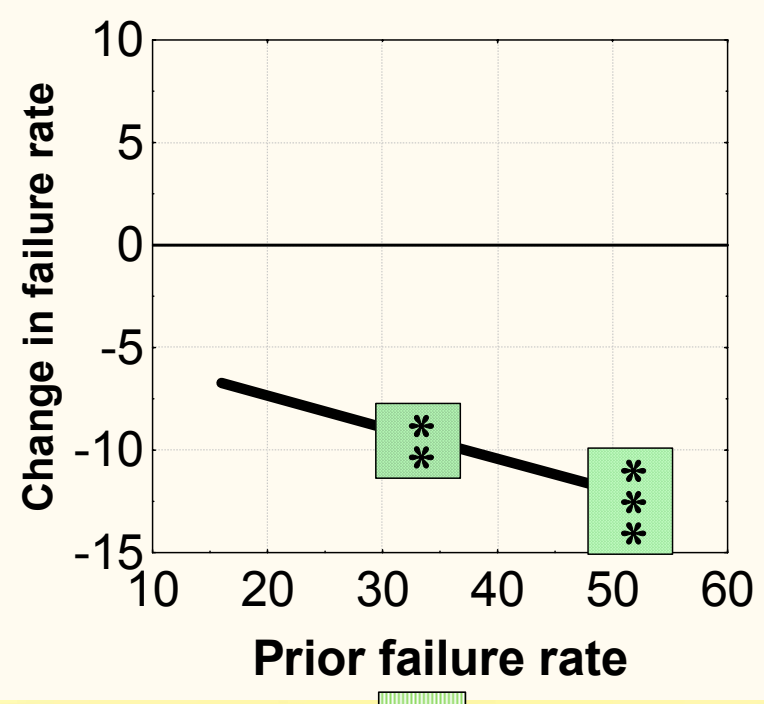
- **If net effect of all "change-in-noise" coefficients is significant, then a relation exists between change in test score and change in noise.**

Partial Results in Table Format

- **Change in failure rate associated with noise reduction: Verbal tests**

Age group	Change in failure rate associated with noise reduction	Confidence that change is real
High	High before: 60% before –12% = 48% after	99.9%
	Med. before: 40% before –10% = 30% after	99 %
	Low before: 15% before – 7% = 8% after	< 90 %
Middle	High before: 60% before – 1% = 59% after	< 50 %
	Med. before: 40% before + 1% = 41% after	< 50 %
	Low before: 15% before + 4% = 19% after	< 90 %
Elem	High before: 60% before – 0% = 60% after	< 50 %
	Med. before: 40% before + 2% = 42% after	< 50 %
	Low before: 15% before + 5% = 20% after	90 %

Same High-School Results in Graphical Format

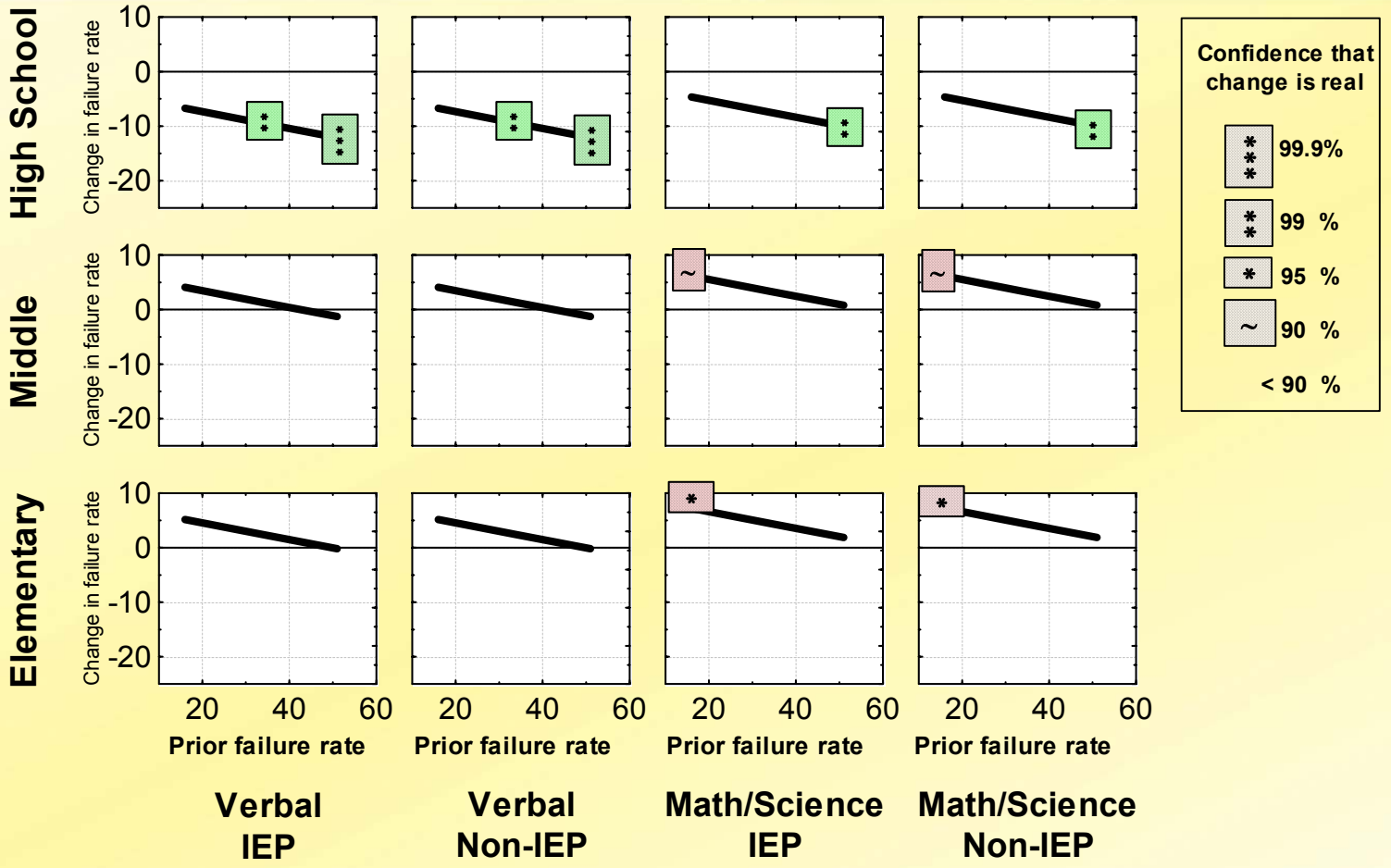


Confidence that change is real	
***	99.9%
**	99 %
*	95 %
~	90 %
	< 90 %

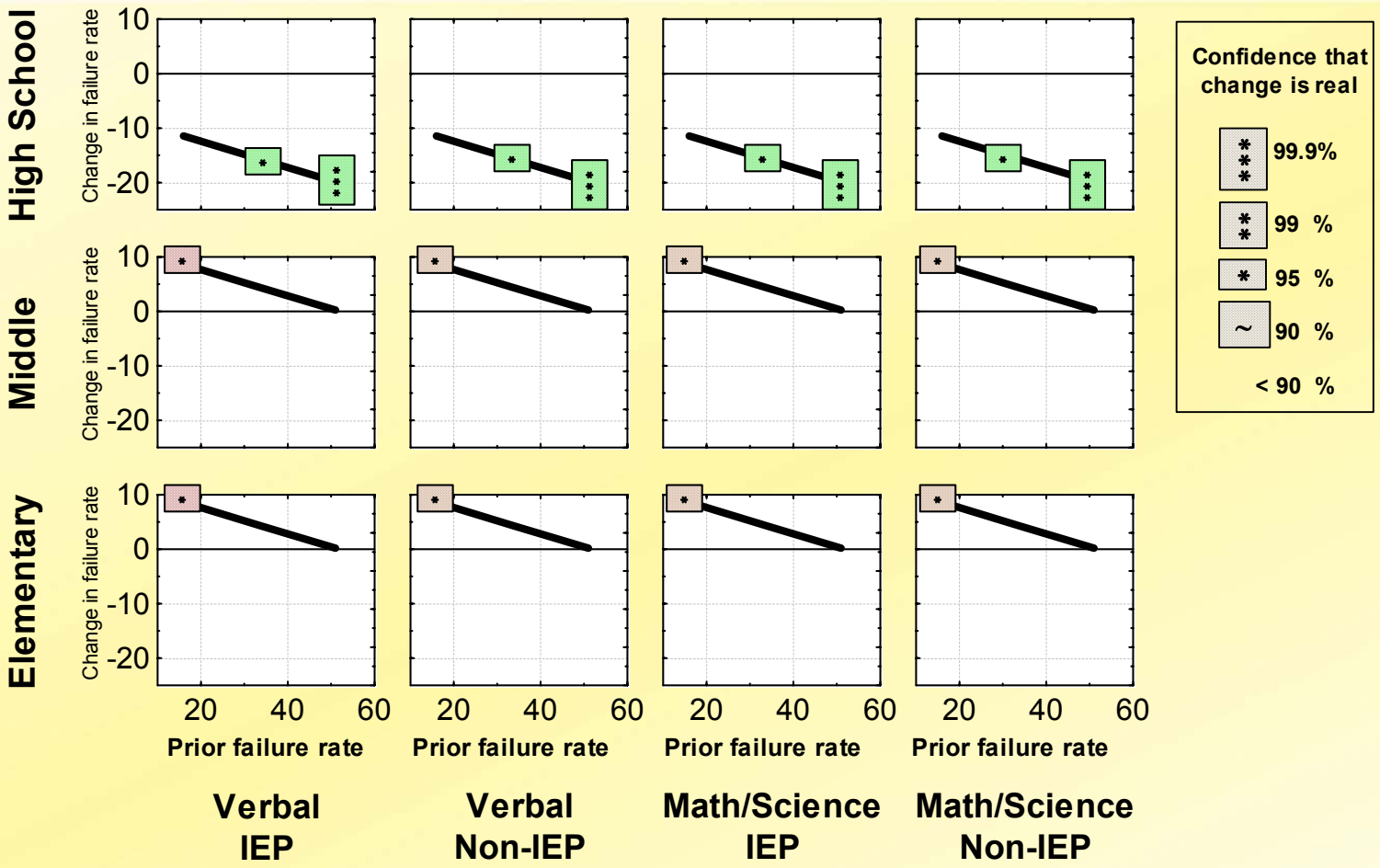
Example

Failure rate			
Prior	**Change**	**After**	**Conf.**
33	-9	= 24	99%

Change in Failure Rate Associated with Noise Reduction



Change in Failure Rate
When %Tm > 40dBA drops by 5 (like 7% to 2%)



Summary of All Results

- Found substantial association between noise reduction and decrease in failure rates, only for high-school students.
- Found some weaker association between noise reduction and increase in failure rates, for middle and elementary schools.
- Found little distinction between IEP and non-IEP students, and between verbal and math/science tests.
- Found little association between noise reduction and changes in "A" rate or average scores.
- ***Caveats:***
  - *Analysis not yet fully validated and reviewed.*
  - *Results should not be used nationally without subsequent studies of many additional airports and schools.*

Recommendations for Any Follow-up Studies

- **Airports/schools:**
  - Include larger number of airports and schools.
- **Students:**
  - Follow individual students from year to year, rather than using only class-average results.
- **Testing location**
  - Identify tests taken in quieter environments.
- **Portable classrooms**
  - Identify classes taught in portable classrooms.
- **Precision of noise computations:**
  - Obtain airport data directly from airports.
  - Incorporate outdoor-to-indoor measurements.