

# F I C A N

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  $L_{A_{max}}$  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:**

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

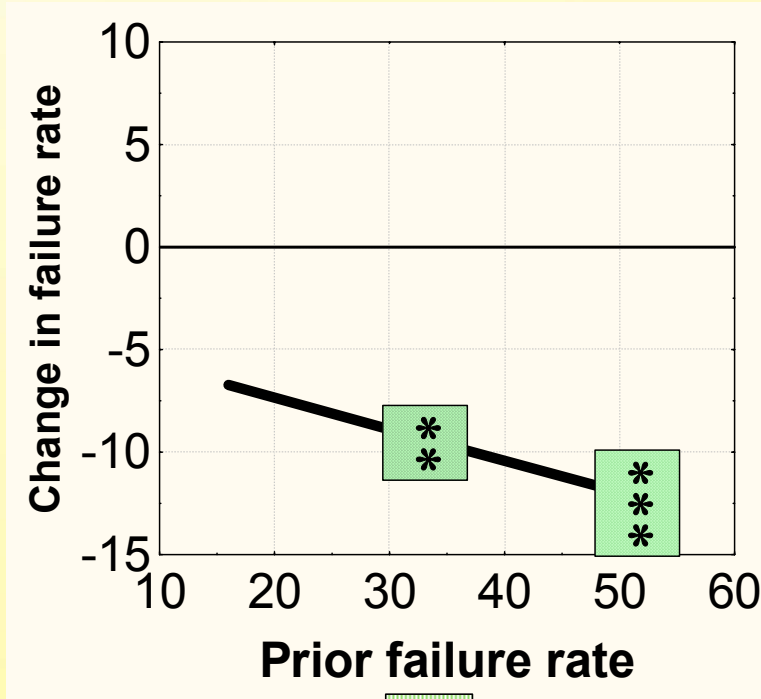
- **If net effect of all “change-in-noise” coefficients is significant,** then a relation exists between change in test score and change in noise.

## 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**

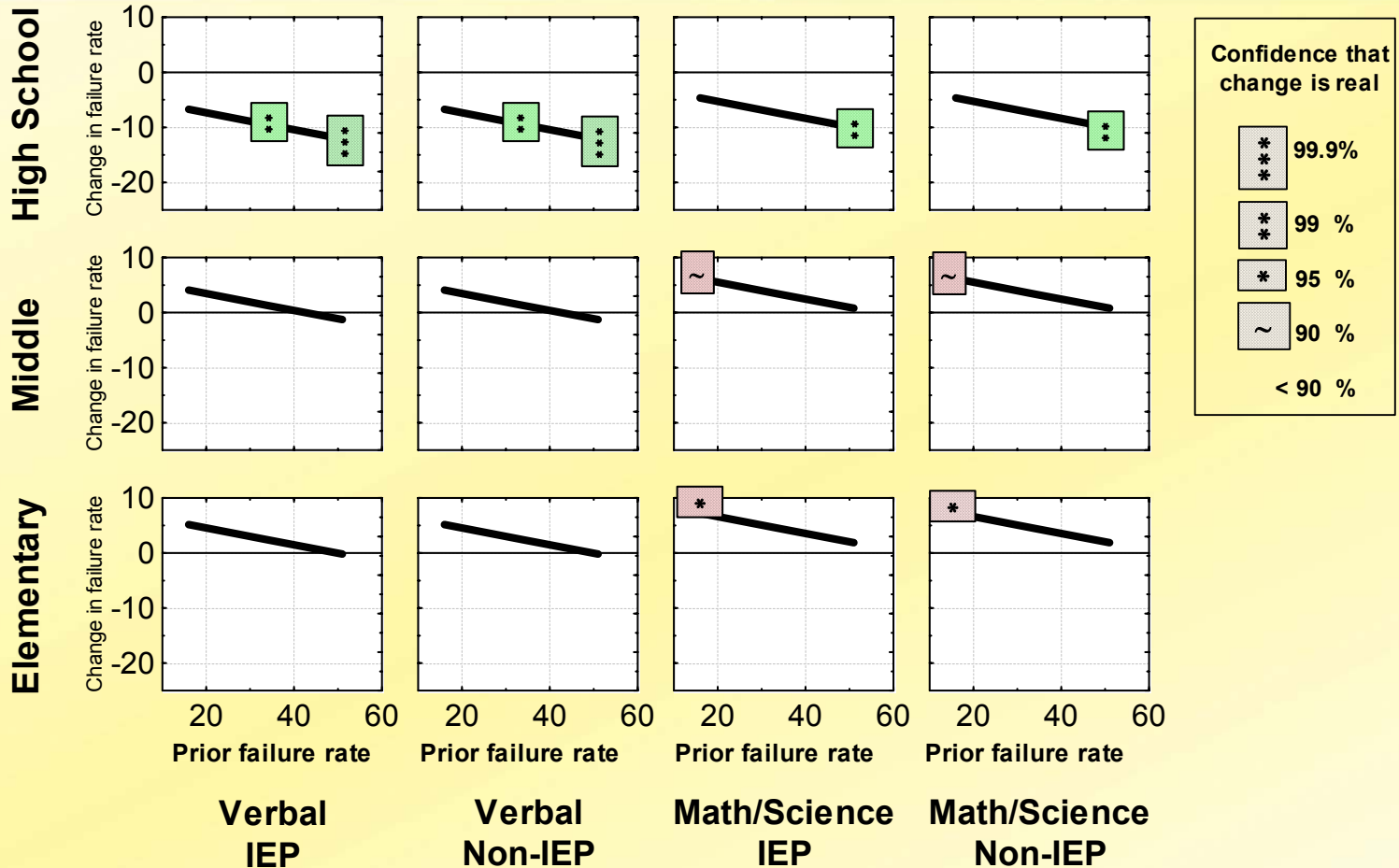
- \*\*\* 99.9%
- \*\* 99 %
- \* 95 %
- ~ 90 %
- < 90 %



## Example

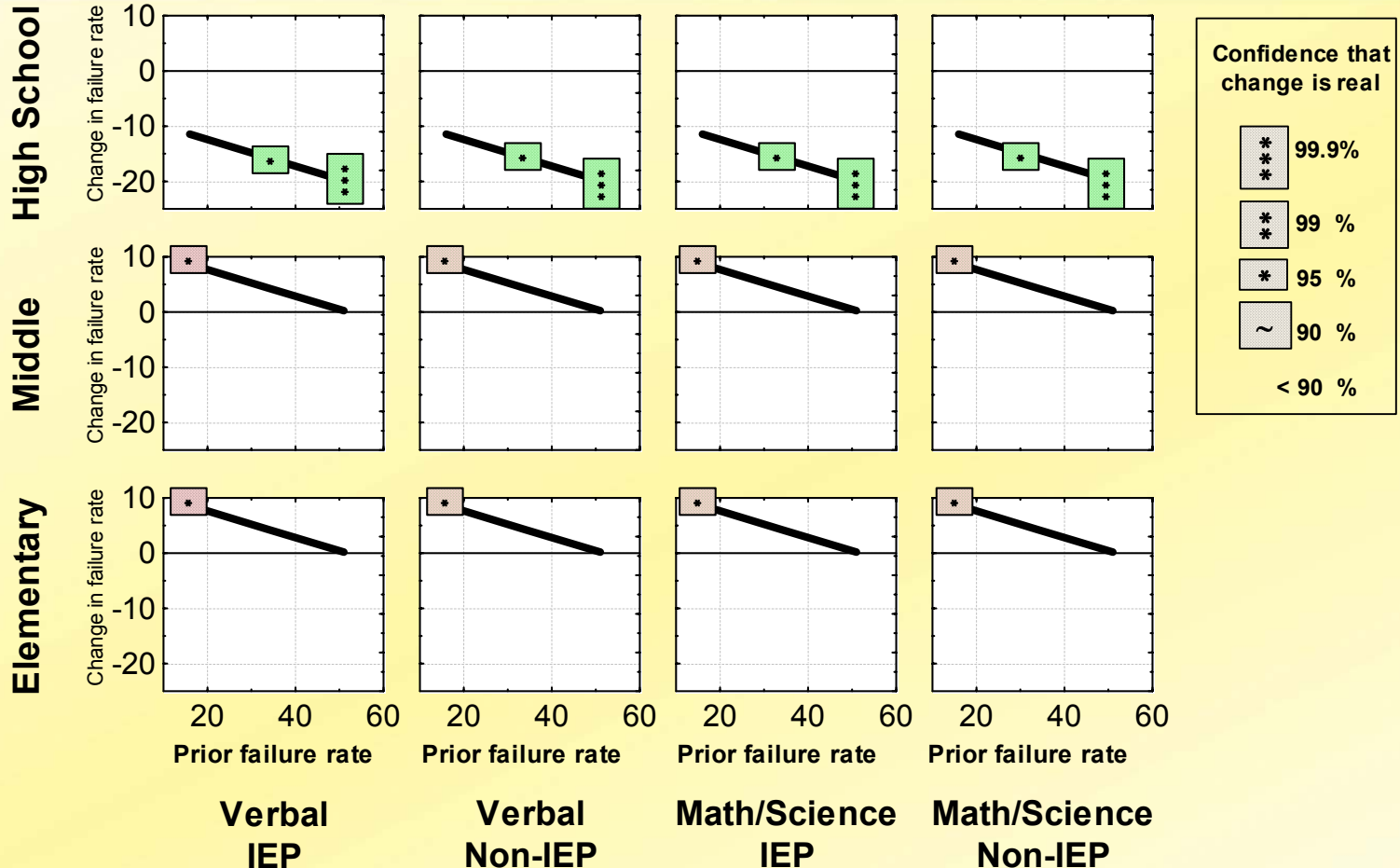
Failure rate			
Prior	Change	After	Conf.
33	-9	= 24	99%

# 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.