Tornadoes, Teaching and Terrorism: Lessons Learned from Survey Research ©

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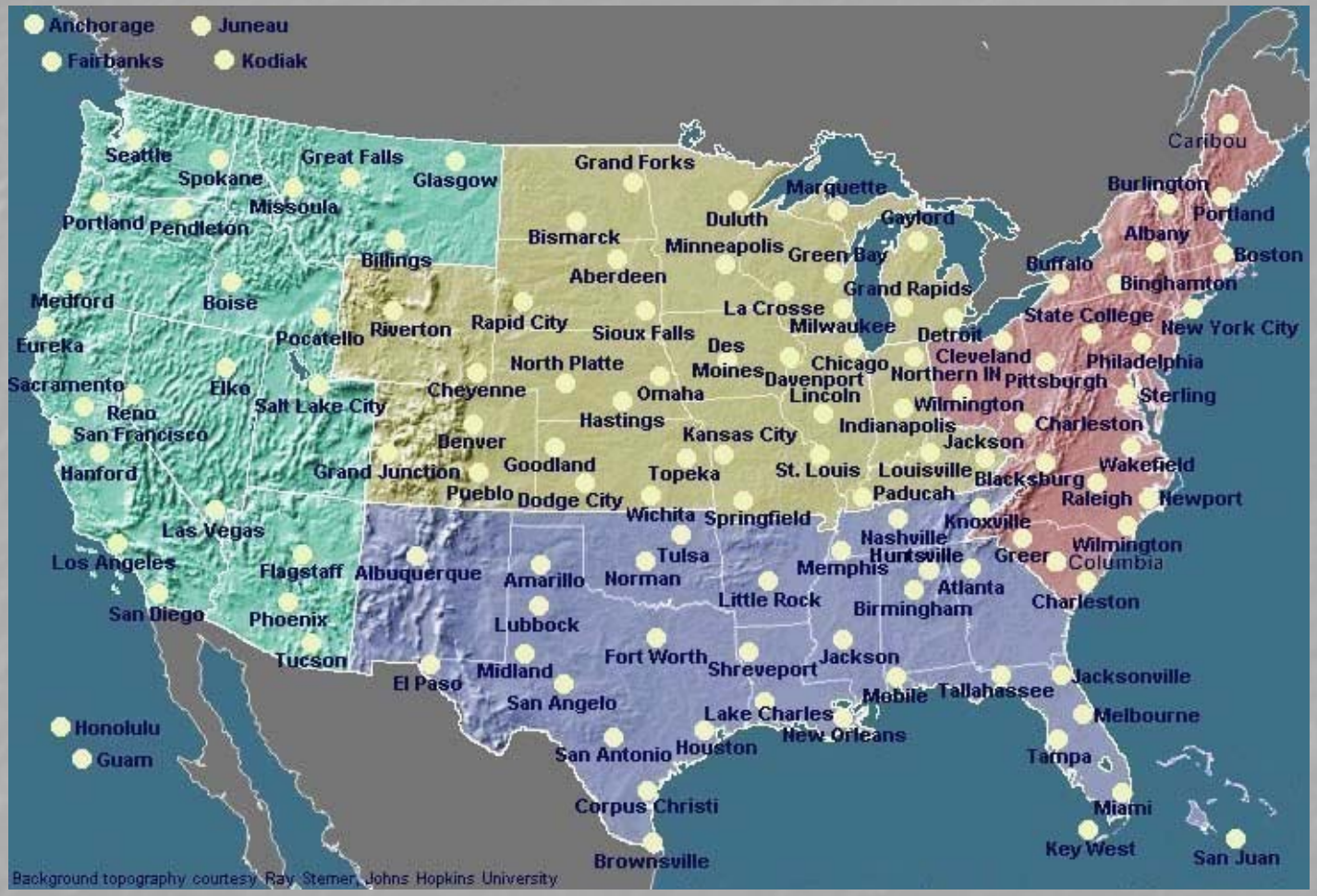
The Impact of Social/Cultural Factors on Tornado Warning Performance

"Science does not float upon the winds, but is inevitably grounded in human relations."

- Professor Gary Fine, Northwestern University

NWS Forecast Offices and Regions *



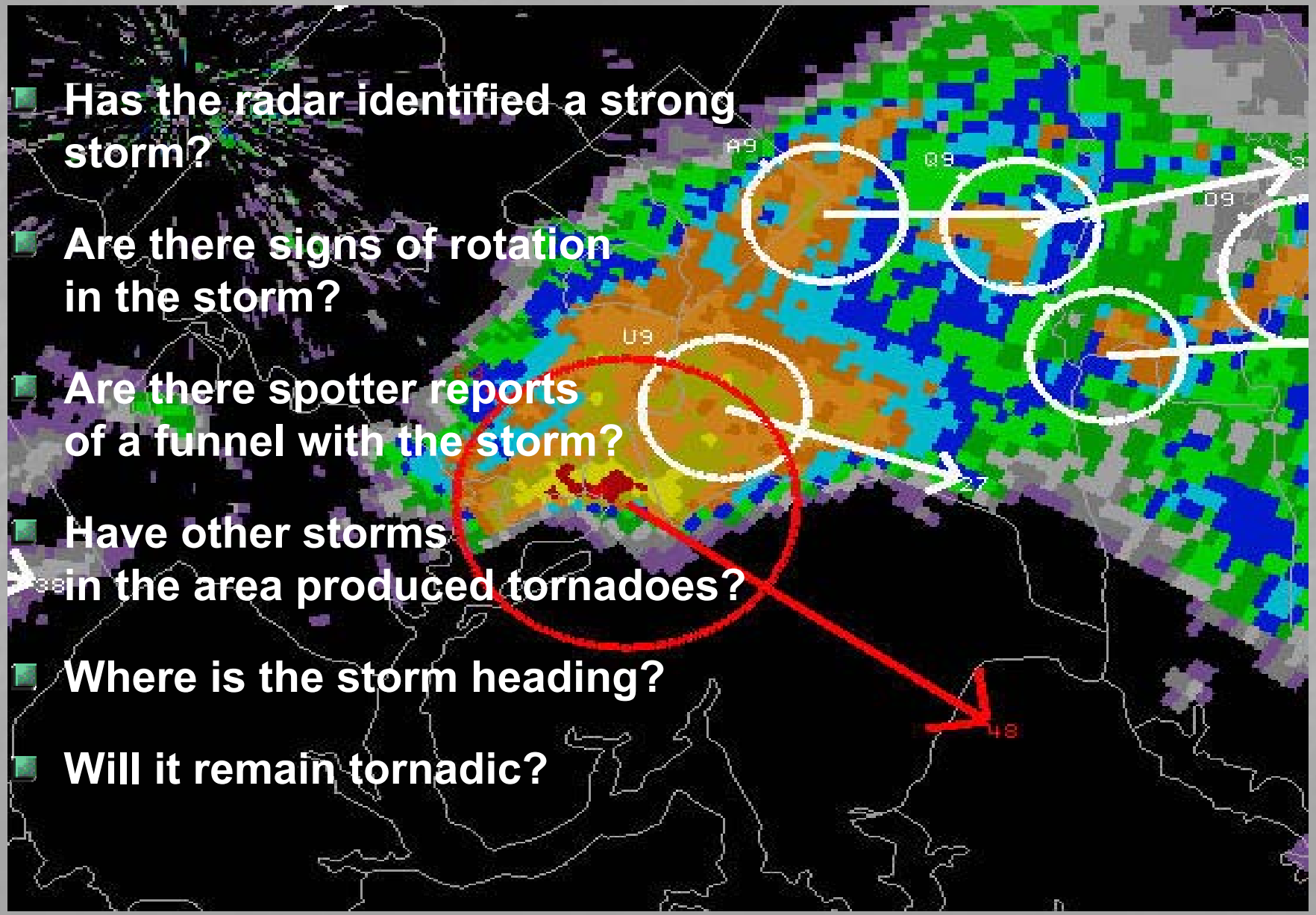
** Offices west of the Rockies were excluded from our analyses, as well as those reporting fewer than five tornado events in 2001/2002 and those with fewer than five employees completing the survey.*

Weather Forecast Office (WFO) Culture

Characteristics

- **"Family" unit of 20-30 people, isolated from other offices**
- **Relatively homogeneous in gender, ethnicity, age**
- **Experienced (10-25 yrs)**
- **Unionized – can be contentious**

Which Storms are Tornadic?



- Has the radar identified a strong storm?
- Are there signs of rotation in the storm?
- Are there spotter reports of a funnel with the storm?
- Have other storms in the area produced tornadoes?
- Where is the storm heading?
- Will it remain tornadic?

Key Measures on 50 WFOs

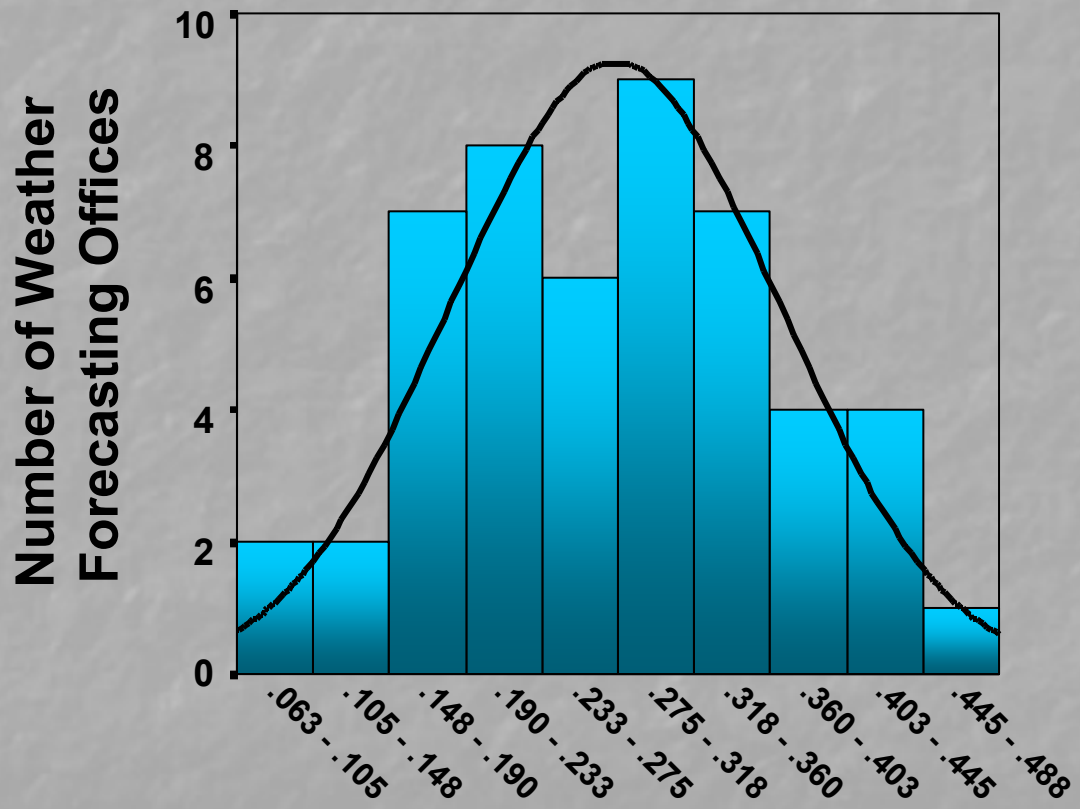
- **Data for 50 Weather Forecast Offices:**
  - **Critical Success Index (CSI)** – key measure of tornado warning performance that combines hits, misses, and false alarms
    - Hits: Number of positive forecasts followed by an event occurrence
    - Misses: Number of occurrences that were not predicted
    - False Alarms: Number of positive forecasts that were not accompanied by an event
  - **Sick leave hours per month** – for each employee
  - **Employee Satisfaction** – from a Sirota survey of 12,000 National Oceanic and Atmospheric Administration (NOAA) employees
    - Conducted as part of a diversity strategy
    - Approximately 130 multiple-choice questions
    - Administered through February of 2002

Key Measures on 50 WFOs (continued)

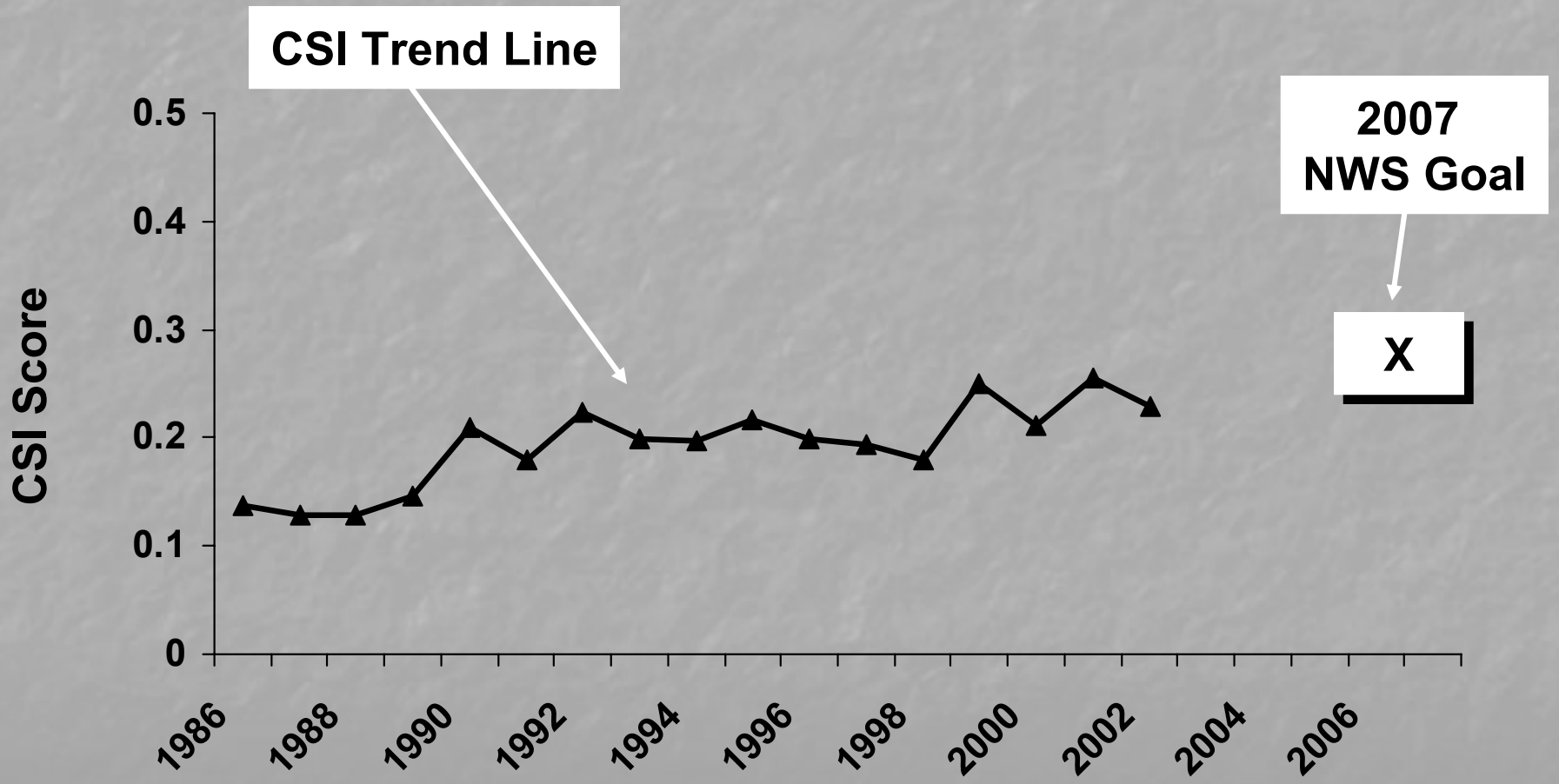
- **Data on 50 Weather Forecast Offices (continued):**
  - **Controlled variables** – several variables thought to affect tornado warning performance accuracy were statistically controlled for:
    - Employee tenure
    - Education level
    - Number of employees at each site
    - Geography
    - Number of tornado events
  - **Other potential influences were comparable across the offices:**
    - Technology
    - The nature of the tornadoes affecting offices (force, etc.)

Variation in CSI Scores Across Offices

Research Question: How do we explain these CSI performance differences for tornado warnings across WFOs?



NWS Tornado Warning Performance



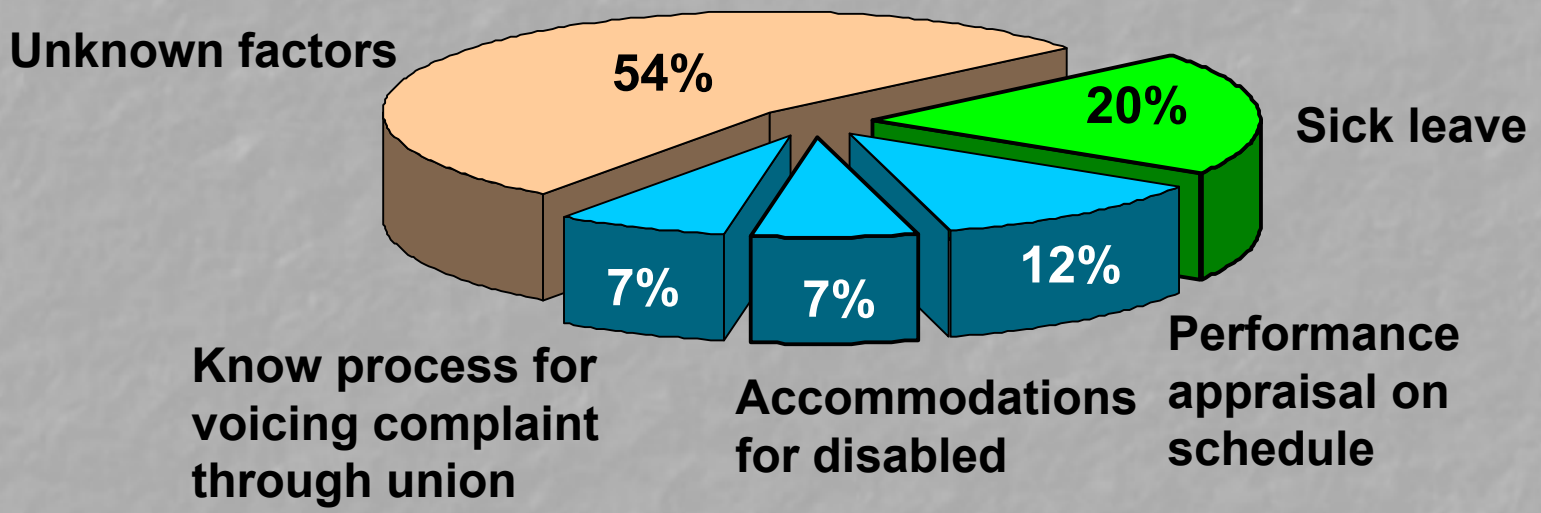
Highest Correlates of Tornado Warning Performance

	r
Sick leave hrs per month per employee (actual sick leave hours per month)	-0.45**
My last performance appraisal was on schedule	0.42**
Reasonable accommodations are made for persons with disabilities (e.g., availability of sign language interpreters, ramps, Braille)	0.38**
I know the process for voicing a complaint or filing a grievance through the union	0.36**
In my Line/Staff Office, work practices and procedures that are no longer needed are eliminated	0.34**
I understand the relationships between the NOAA Line/Staff Offices	0.30*
Differences among individuals are understood and accepted (e.g., gender, race, religion, age, sexual orientation, disability)	0.28*
Diverse groups (e.g., work teams, customers) participate in the development of performance measures where I work	0.28*
The results of the 1998 SFA were used constructively by management	0.26*
I know where to find information concerning my rights as a federal employee	0.25*
I know how to contact the appropriate union official if I need to	0.24*
I understand that the union is the exclusive representative of NWS bargaining unit employees	0.24*

*Pairwise $n = 50$; * $p < .05$; ** $p < .01$*

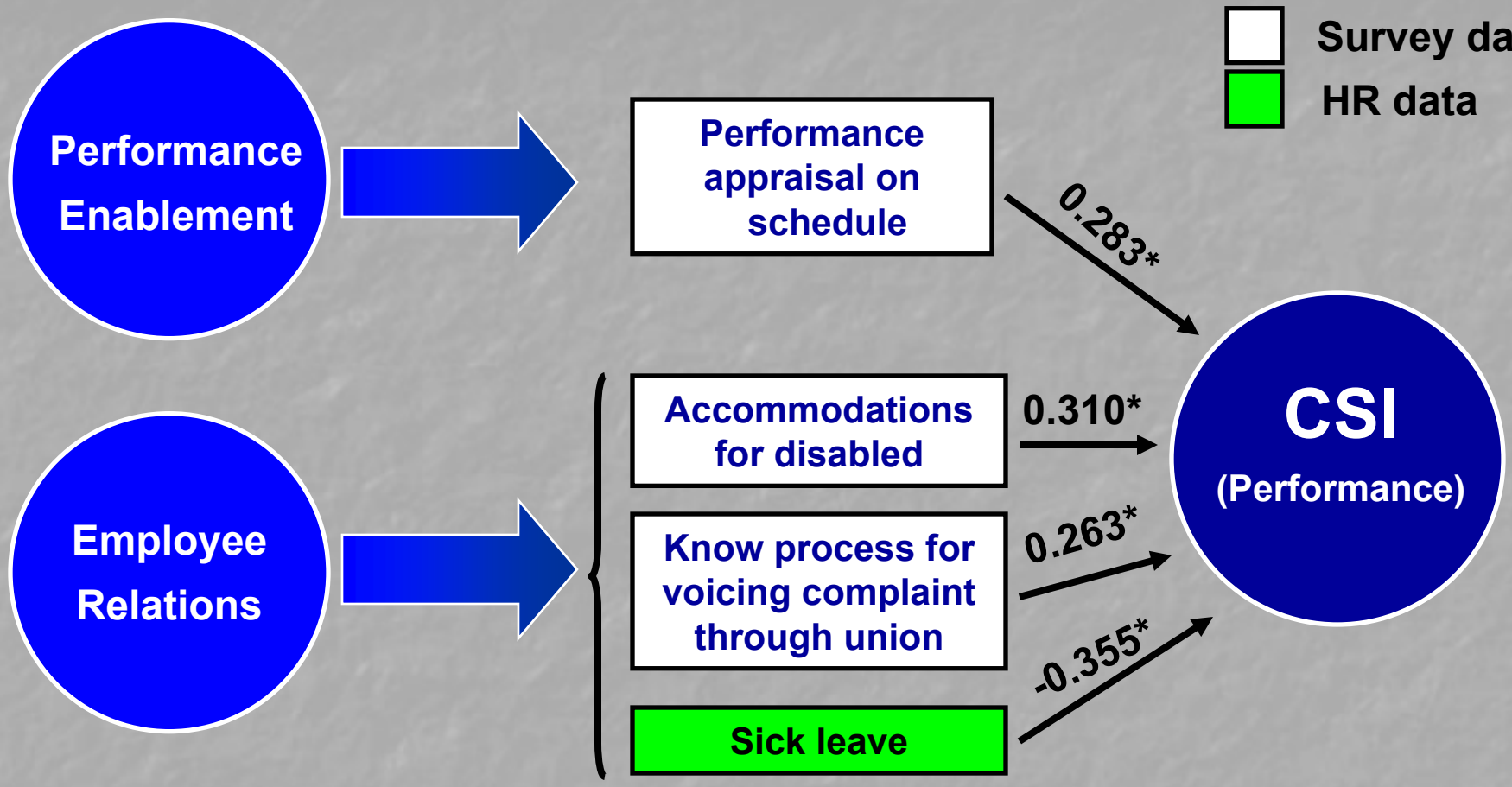
Regression Analysis

Nearly half of the differences in WFOs' performance are accounted for by four variables:



* Results based upon stepwise regression analysis

Conceptual Model



The most important factors in tornado warning performance reflect managerial effectiveness: Performance Orientation and Employee Relations

*** Values are Standardized Beta coefficients**

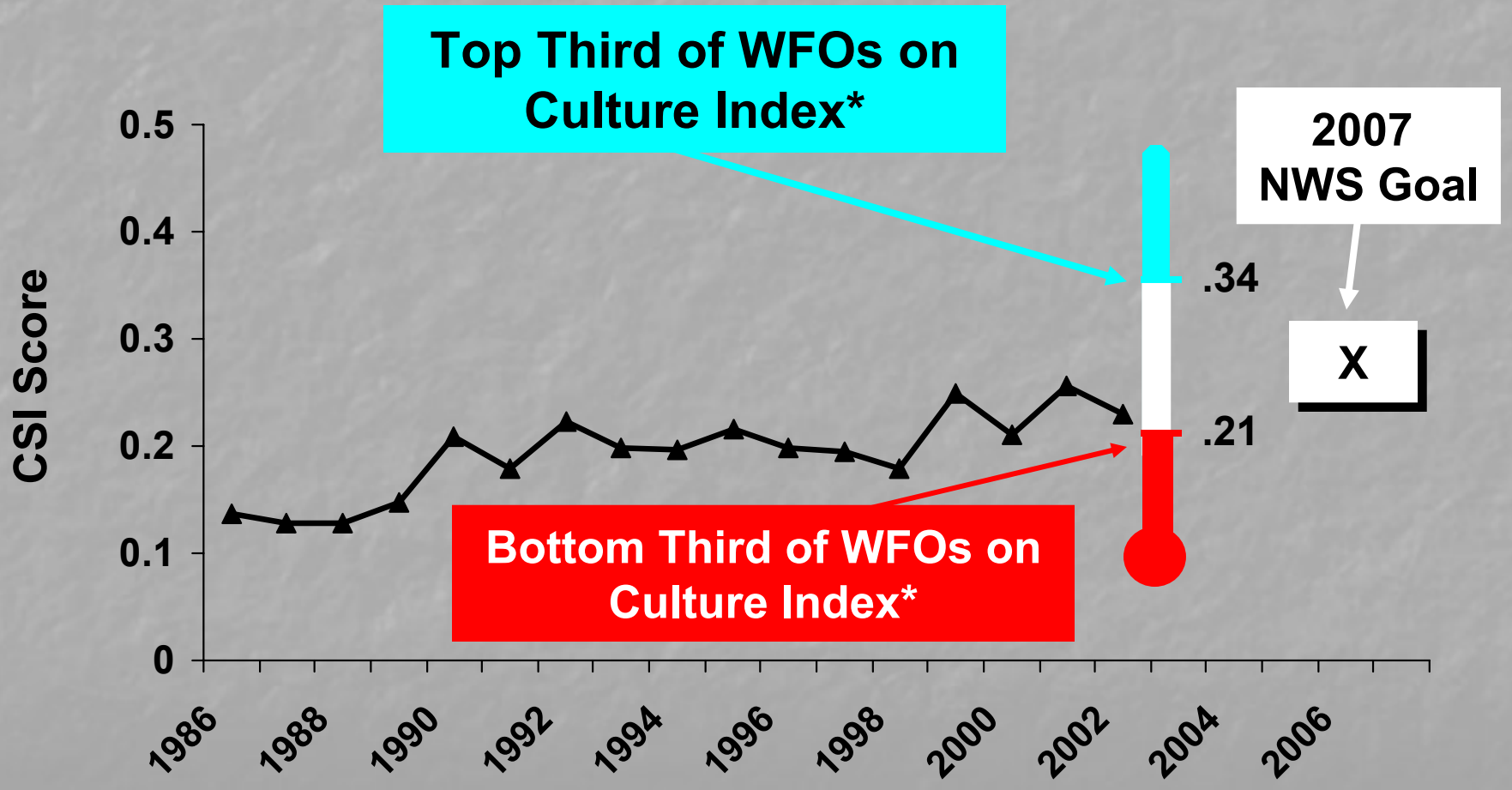
Highest Survey Correlates of Sick Leave

- A clear pattern of relationships emerges:
  - Work group cooperation and teamwork
    - Within work groups (r = -0.30 *)
    - Between work groups (r = -0.41 **)
  - Supervisor behavior
    - Responsive to employee ideas (r = -0.40 **)
    - Fair (r = -0.36 *) and Supportive (r = -0.35 *)
    - Relationship with union representative (r = -0.40 **)
  - Performance and diversity
- In other words . . .
  - WFO culture has a strong and consistent impact on sick leave
  - And, ultimately on tornado warnings

** p < .05; ** p < .01*

NWS Tornado Warning Performance

WFOs performing best on cultural variables have reached the NWS goal four years ahead of schedule:



*The Culture Index comprises the following items: Performance appraisal on schedule, Accommodations for disabled and Know process for voicing complaint through union

Conclusion

- Improvements in technology are extremely important to improve tornado warning performance. They promise to raise the performance of *all* offices.
- In addition, we have found that leadership in *individual* Weather Forecast Offices also has a demonstrable impact on performance.
- In fact, the quantitative goal of excellence the National Weather Service has set for itself could be achieved by attending to these cultural variables alone.

Linking Perceptions of School Culture to Student Performance

Objective and Methodology

- To help assess the performance of and determine priorities for improvement in a major metropolitan school district (over 4,000,000 residents in the city and local area)
- Multi-Constituency Survey
  - Constructed using the input of teachers, Board members, parents, students and key citizen groups and individuals
  - Administered to District employees (teachers, principals, other staff, etc.), parents, and students in 224 schools
  - 75,000 respondents (approximately 50% response rate) *
- Data were aggregated by School as the unit of analysis
  - Raw data were converted to mean scores for all questionnaire items

* The eligible parent population (actually the number of households) had to be estimated due to multiple last names per household, multiple households per family, etc.

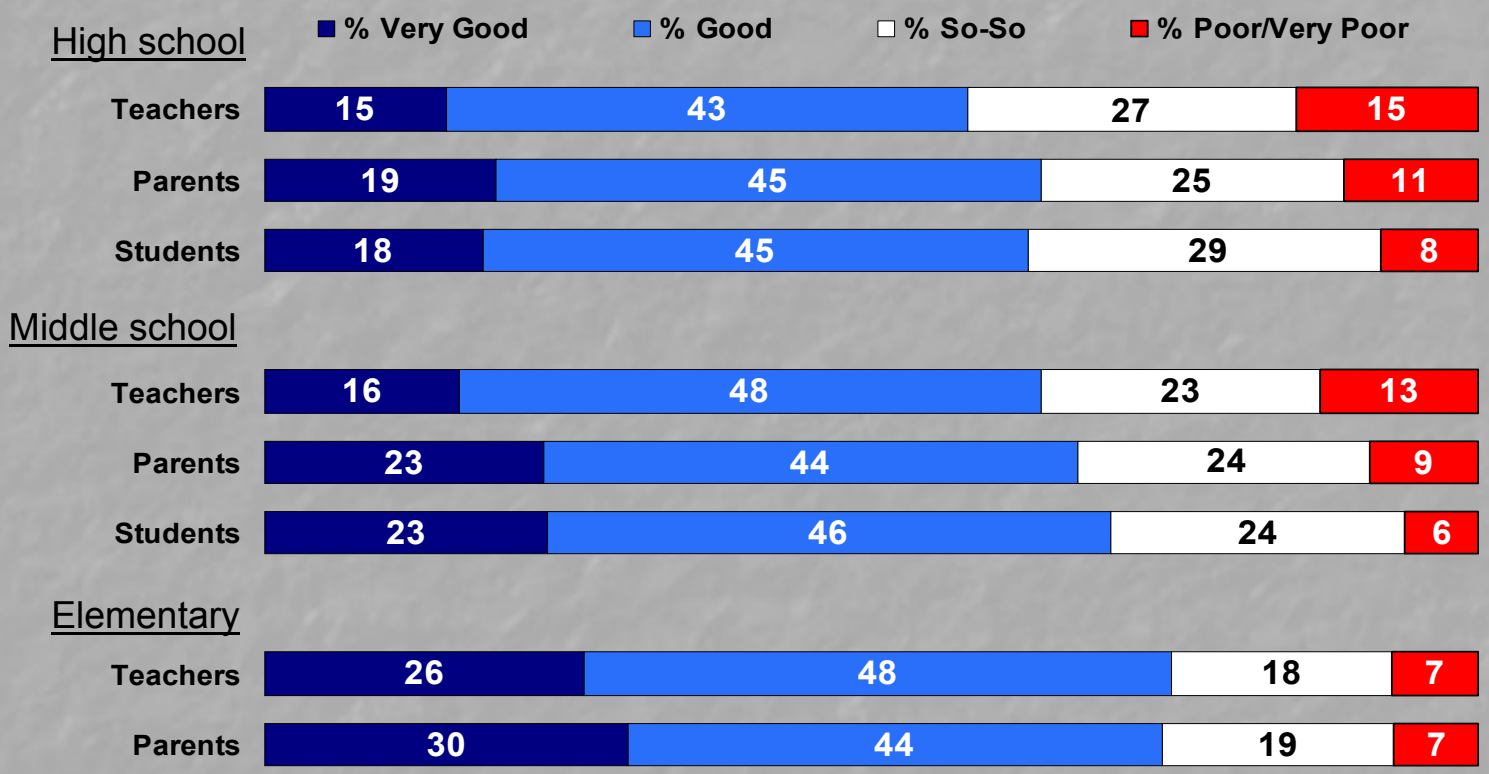
Reliability and Validity of Data

- Reliability and validity of the data were supported through several preliminary analyses, including:
  - Correlations for perceived quality of education among the constituencies
  - Correlations between perceived quality of education and performance on the Iowa Test of Basic Skills – ITBS

Agreement Among Constituencies

Table 1

Perceived Quality of Education by Type of School and Constituency



There is extraordinary agreement among the three constituencies in their views of education quality on an overall basis and school-by-school

Agreement Among Constituencies (continued)

TABLE 2

Agreement Among Three Constituencies:

Correlations in Perceived Quality of Education *

(School as Unit of Analysis)

	r
Teachers vs. Parents	0.68 **
Teachers vs. Students	0.78 **
Students vs. Parents	0.81 **

* "How would you rate your school on providing high quality education to students?"

** Statistically significant at $p < .001$

Linking Perceptions and Performance

TABLE 3

Linkage between Attitudes and Actual Student Performance:

Correlations between Perceived Quality of Education and ITBS Scores*

(School as Unit of Analysis)

	r
Teachers	0.66 **
Parents	0.63 **
Students	0.65 **

* "How would you rate your school on providing high quality education to students?"

** Statistically significant at p < .001

Some Descriptive Results

- Positive District-wide findings:
  - Overall education quality
  - Educational standards
  - Overall performance of teachers and principals
- However:
  - While teachers are rated quite positively overall, a number are viewed as much less competent and many feel the District does not face up to this problem
  - Teachers are more positive about their performance than are students -- including their view that they have higher standards than students say they have
  - Teachers see various obstacles to their performance, e.g., inadequate training, deficiencies in student preparation for next school level

Linking Attitudes to Performance

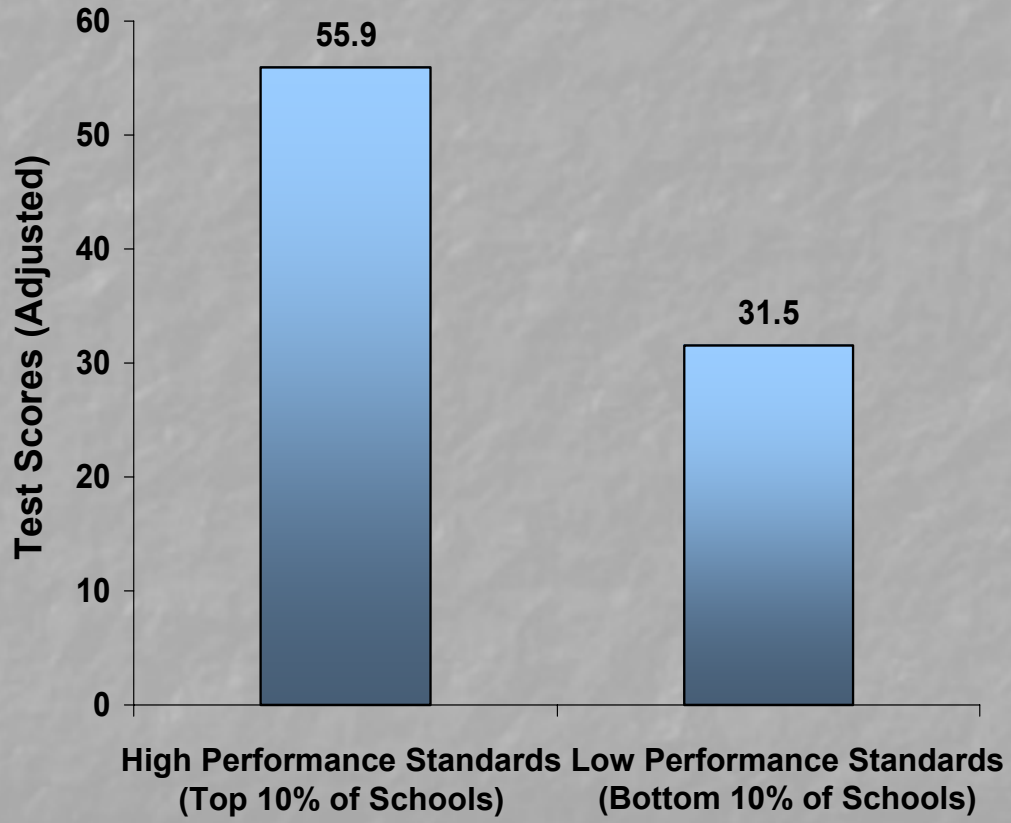
- Holding constant socioeconomic status and the stringency of entrance requirements, four factors correlated consistently (across constituencies) and highly with test scores: *
  - **Performance Standards and Quality of Education**
    (School has high standards, Quality of language arts education, Quality of math education)
  - **Teacher Style and Competence**
    (Competence, Enthusiasm, Motivation, Listening)
  - **School Leadership**
    (Sense of direction, Innovation, Interest in well-being of employees, Employee placement, Relationship with community and business)
  - **Parental involvement / Use of volunteers**
    (Getting parents involved, Effective use of volunteers)

* In addition, special schools for disciplinary problem students were dropped from the analysis.

Linkage Findings (continued)

Table 4

Perceived Performance Standards vs. Student Performance



The questionnaire item used in this graph is:

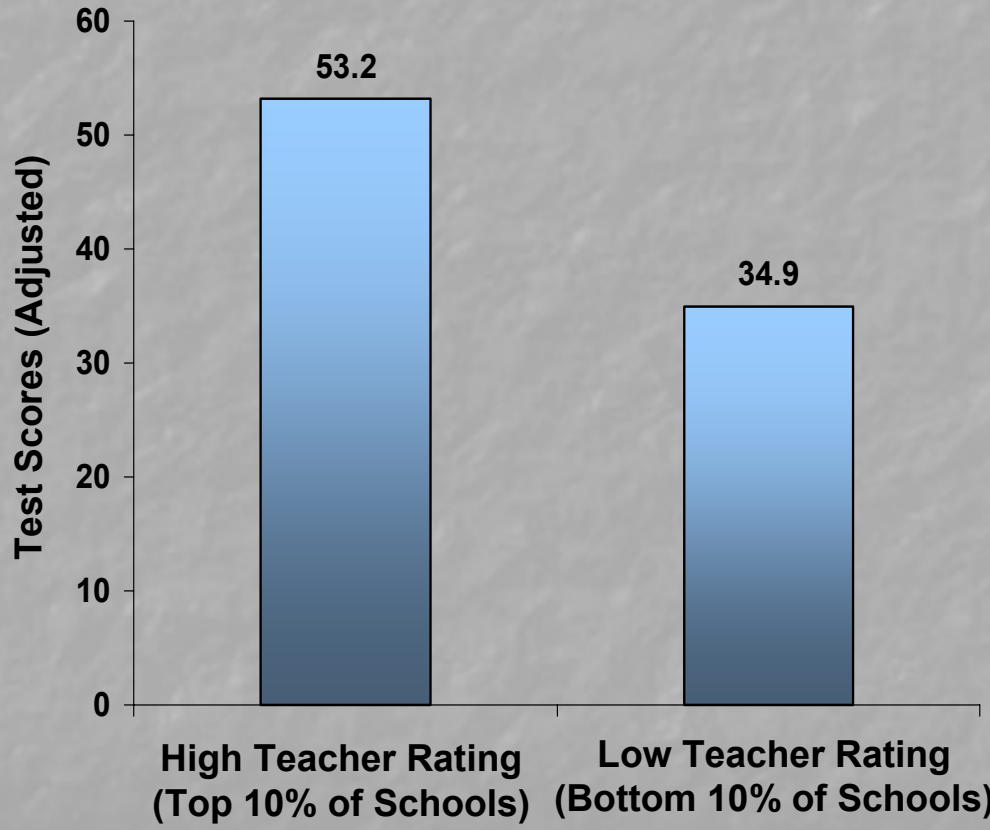
"How would you rate your school on having high performance standards for students?"

If perceived standards are very high, the percentile achievement of students on the ITBS is 55.9, while if they are low, the achievement is 31.5.

Linkage Findings (continued)

Table 5

Perceived Teacher Quality vs. Student Performance



The questionnaire item used in this graph is:

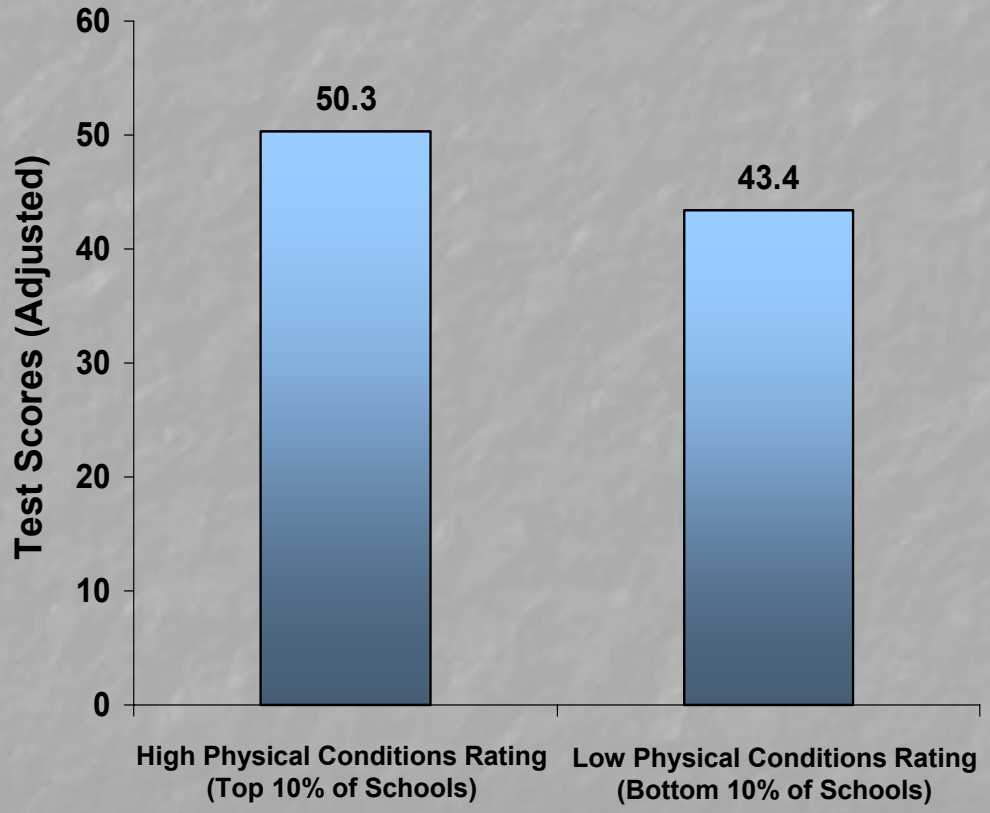
"How good a job is being done by teachers in your school?"

Schools with very high quality teachers have students who perform much above those in schools with lower quality teachers.

Linkage Findings (continued)

Table 6

Attitudes Towards Physical conditions vs. Student Performance



The questionnaire item used in this graph is:

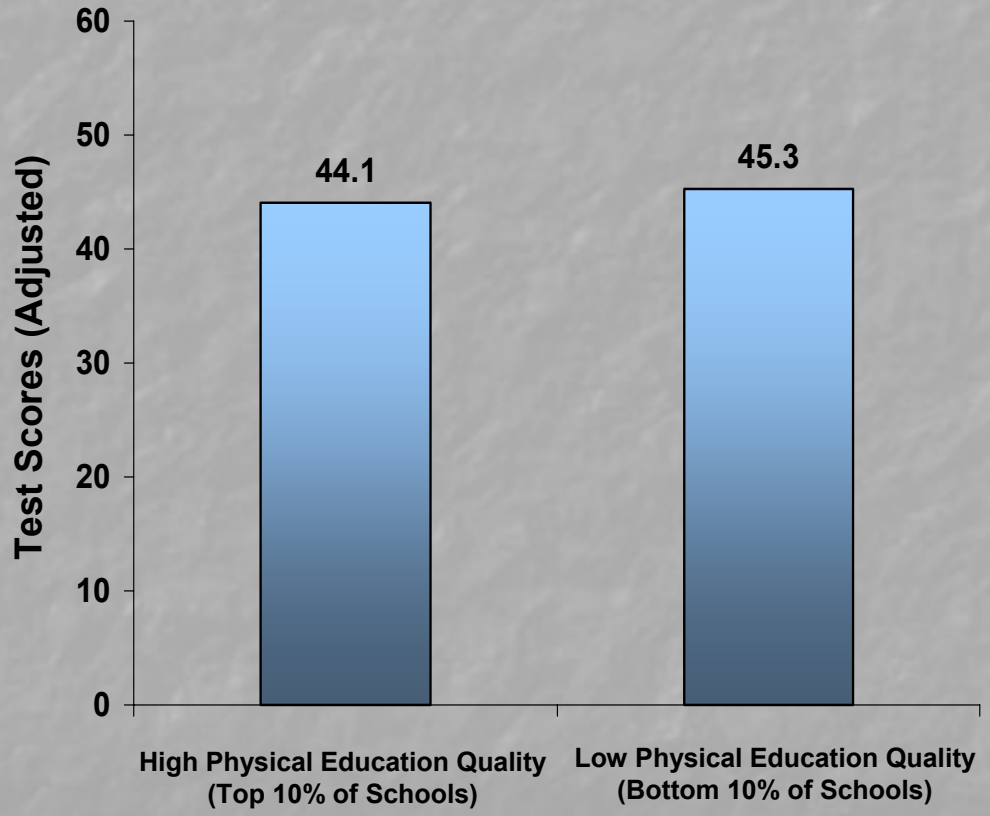
"How would you rate the physical condition of your school building?"

It can be seen that the difference in average student performance between the schools rated high, and those rated low, on physical conditions is considerably smaller than the differences found with the previous items, the ones having higher correlations

Linkage Findings (continued)

Table 7

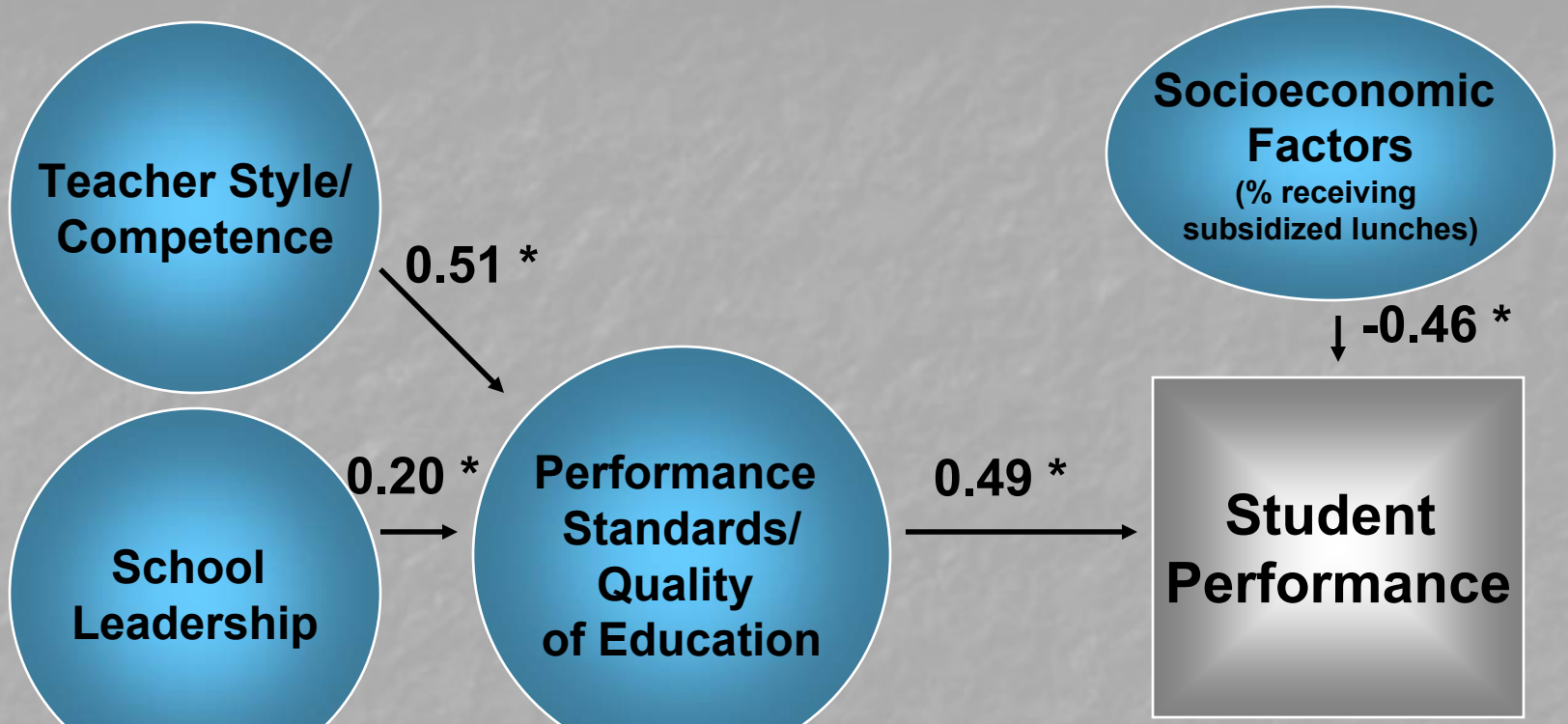
Attitudes Towards Physical Education vs. Student Performance



There is almost no difference between the test performance of the schools rated high, and those rated low, on physical education.

Putting all of the Pieces Together *

Linking Teachers' Perceptions to Student Performance



Teachers, School Leadership, and Parents/Volunteers impact Student Performance through Standards/Quality of Education, *after accounting for socioeconomic factors*.

* Values represent path coefficients using LISREL

Conclusions

- Strongest relationships with performance found with:
  - Performance standards
  - Quality of teachers
  - School leadership
  - Parental involvement/Use of volunteers
- More moderate relationships found with “resources,” such as physical condition of schools and textbooks
- No relationships found with quality of schools’ physical education/athletic programs or quality of music education
- The educational basics – the “blocking and tackling” – matter most for performance.
  - Put incompetent teachers in beautiful new facilities and result is low performing students in beautiful new facilities!
  - Set low or ambiguous performance expectations for students and performance cannot be high for long – no matter what else is done!
- Very similar to what we find in companies: performance standards, managerial competence, leadership – the basics – are critical
- Findings integrated into District’s strategic plan and into plans of individual schools (their own data)

The Impact of Management Status and Proximity on Post 9/11 Attitudes

September 11th

- As tragic a day as any that could be imagined or remembered . . .
  - A challenge for businesses became how to minimize its impact on ongoing operations
  - And understand what becomes salient for the workforce during times of tragedy
- Survey administration had begun August 27, 2001. Prior to September 11th 40% of the 70,000 employees had completed their surveys
- This presented an "opportunity" to assess some of the ways employees may have been affected . . .

  . . . and, more importantly, what might need to be done to support them

September 11th

- **In general, attitudinal impact Company-wide was small:**

	% Favorable Across All Items	
	Before	**After**
Total (n=70,000)	**77%**	**74%***

** p < .05*

September 11th

- **In general, attitudinal impact Company-wide was small:**

	% Favorable Across All Items	
	Before	**After**
Total (n = 70,000)	**77%**	**74%***

- **Controlling for Management Status, the results again revealed only a small decline – and only for Non-Management:**

	% Favorable Across All Items	
	Before	**After**
Management (n = 16,639)	**78%**	**78%**
Non-Management (n = 51,351)	**75%**	**71%***

** $p < .05$*

September 11th

- **However, when the area was limited to the impact zone, Geography and Management Status both mattered:**

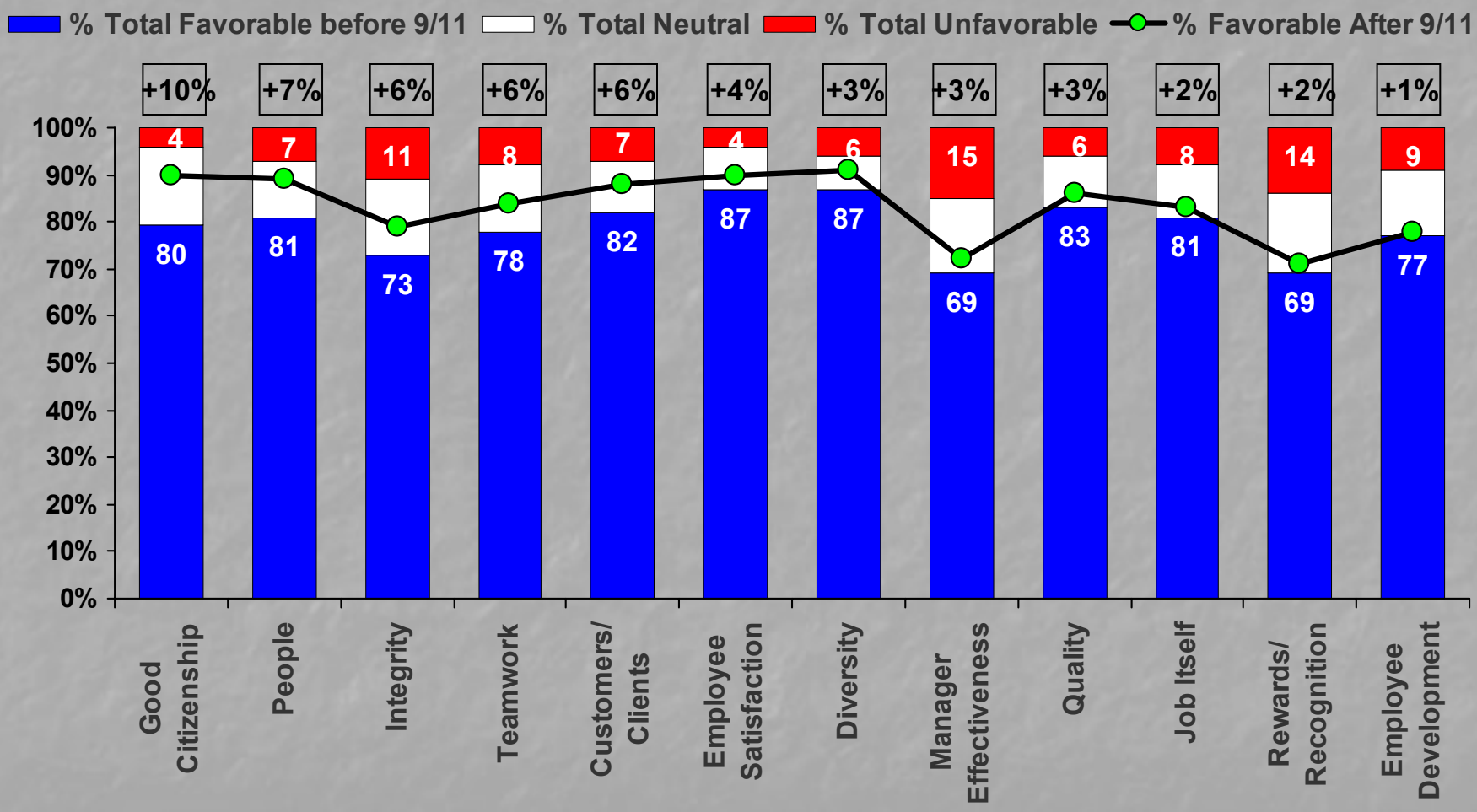
	% Favorable Across All Items	
	Before	**After**
New York City Impact Zone		
Management (n = 897) **	**77%**	**81%***
Non-Management (n = 476)	**81%**	**64%***

** NOTE: This was a corporate headquarters, predominated by management personnel

* $p < .05$

2001: Impact Zone Management

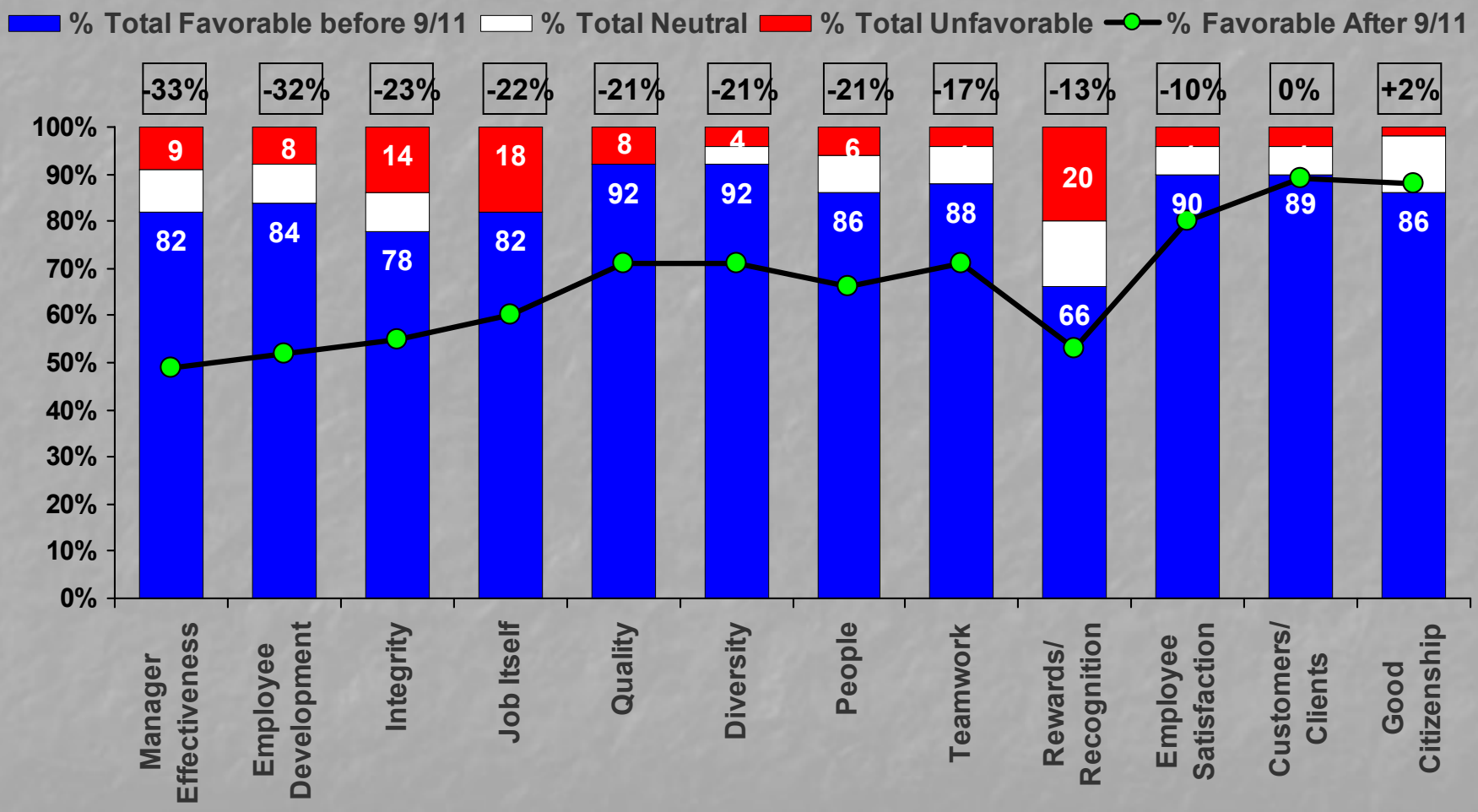
Ranked by Difference in % Favorable Post 9/11 – N=897



- **Most attitudes improved – particularly around People and Community**
- **Many felt they were doing important work and were empowered to address both customer and employee crises**

2001: Impact Zone Non-Management

Ranked by Difference in % Favorable Post 9/11 – N=476



- **Nearly all dimensions declined – especially Manager Effectiveness and Development**
- **Many were concerned about what all of the turmoil meant for them: where will they work?, how will they work?, where will the needed money come from?, etc…**

One Year Later – 2002 Survey

- In 2002, survey administration was conducted during the same time period as in 2001
  - About 64,000 responded to the 2002 survey
  - The company had downsized somewhat – response rate was nearly identical
- Although much had changed since 9/11 2001, an opportunity existed to compare attitudes following the tragedy with those businesses who had mostly remained in the New York area (many had relocated to other parts of the country)

2002 Impact Zone – Management

Among those businesses present in 2001 and 2002

Dimension	Pre 9/11	Post 9/11	Post minus Pre
Count	*172*	*120*	
Job Itself	79	83	+4
Good Citizenship	84	90	+6
Manager Effectiveness	69	71	+2
Employee Development	76	79	+3
Customers/Clients	83	86	+3
Employee Satisfaction	87	90	+3
Integrity	75	79	+4
Teamwork	83	84	+1
Quality	85	87	+2
Diversity	90	90	0
Rewards/Recognition	68	72	+4
People	84	89	+5

- Again, as we had observed, attitudes improved somewhat following 9/11 (particularly People and the Community).

2002 Impact Zone – Management

Among those businesses present in 2001 and 2002

Dimension	Pre 9/11	Post 9/11	Post minus Pre	2002	2002 minus Post	2002 minus Pre
Count	*172*	*120*		*589*		
Job Itself	79	83	+4	78	-5	-1
Good Citizenship	84	90	+6	82	-8 *	-2
Manager Effectiveness	69	71	+2	66	-5	-3
Employee Development	76	79	+3	72	-7	-4
Customers/Clients	83	86	+3	79	-7	-4
Employee Satisfaction	87	90	+3	82	-8 *	-5
Integrity	75	79	+4	70	-9 *	-5
Teamwork	83	84	+1	78	-6	-5
Quality	85	87	+2	79	-8 *	-6 *
Diversity	90	90	0	83	-7 *	-7 *
Rewards/Recognition	68	72	+4	61	-11 *	-7 *
People	84	89	+5	76	-13 *	-8 *

*** Significant difference at $p < .10$**

- **Yet one year later (during the period of Non-Management rebound), attitudes had trended to their lowest levels, and lower than pre-9/11.**

2002 Impact Zone – Non-Management

Among those businesses present in 2001 and 2002

Dimension	Pre 9/11	Post 9/11	Post minus Pre
Count	*45*	*59*	
Good Citizenship	80	84	+4
Integrity	73	55	-18 *
People	84	66	-18 *
Employee Satisfaction	92	80	-12
Rewards/Recognition	68	53	-15 *
Customers/Clients	90	89	-1
Manager Effectiveness	76	49	-27 *
Job Itself	76	60	-16 *
Quality	92	71	-21 *
Diversity	88	73	-15 *
Teamwork	81	71	-10
Employee Development	81	52	-29 *

*** Significant difference at $p < .10$**

- As we had already observed, Non-Management attitudes declined tremendously after 9/11.

2002 Impact Zone – Non-Management

Among those businesses present in 2001 and 2002

Dimension	Pre 9/11	Post 9/11	Post minus Pre	2002	2002 minus Post	2002 minus Pre
Count	*45*	*59*		*110*		
Good Citizenship	80	84	+4	88	+4	+8
Integrity	73	55	-18 *	78	+23 *	+5
People	84	66	-18 *	88	+22 *	+4
Employee Satisfaction	92	80	-12	94	+14 *	+2
Rewards/Recognition	68	53	-15 *	69	+16 *	+1
Customers/Clients	90	89	-1	90	+1	0
Manager Effectiveness	76	49	-27 *	75	+26 *	-1
Job Itself	76	60	-16 *	73	+13 *	-3
Quality	92	71	-21 *	88	+17 *	-4
Diversity	88	73	-15 *	84	+11	-4
Teamwork	81	71	-10	77	+6	-4
Employee Development	81	52	-29 *	71	+19 *	-10

*** Significant difference at $p < .10$**

- One year later – and during trying economic conditions – attitudes rebounded to levels similar to pre 9/11
- Except for Employee Development – lowest level

Thoughts and Conclusions

- **During traumatic events, Management becomes "outer-directed," Non-Management becomes "inner-directed."**
  - **A strong prescriptive finding when considering the needed communications during such times.**
- **Perhaps the mediating mechanism is self-efficacy?**
  - **On 9/12/01, Management had been empowered and was quickly able to point to the things they were accomplishing – hence the improvement**
    - **Yet once the plans were in place, Management was left to deal with the pressures of a down economy – and ultimately a year where Corporate had to cut back and managers were less in control. Reward programs were capped, spending cut, etc. – hence the ultimate declines.**
  - **Conversely, on 9/12/01, Non-Management was considerably less able to accomplish their activities and left with more questions than answers**
    - **Yet once Management completed their "return to downtown plan," and the focus returned to People, Customers and Financials (as it historically had been), things immediately became clearer for Non-Management – and they were again in control of their worklives – although individual Development activities continue to suffer from budget pressures.**
    - **Hence the strong rebounds – even in difficult times**

Thoughts and Conclusions (continued)

- **Strong leadership will play an important role in mitigating the impact of turmoil on the workforce.**
  - **By focusing not only on logistics issues but also very basic employee concerns about "what does this mean for me and what I do here?" By addressing their equity and achievement concerns, management can help assure, focus and energize their employees.**
  - **Senior leadership must anticipate and continuously assess the longer-term impact of turmoil on its middle and lower managers.**

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