

# Communicating the Excitement of CS: K-12 Outreach Practices

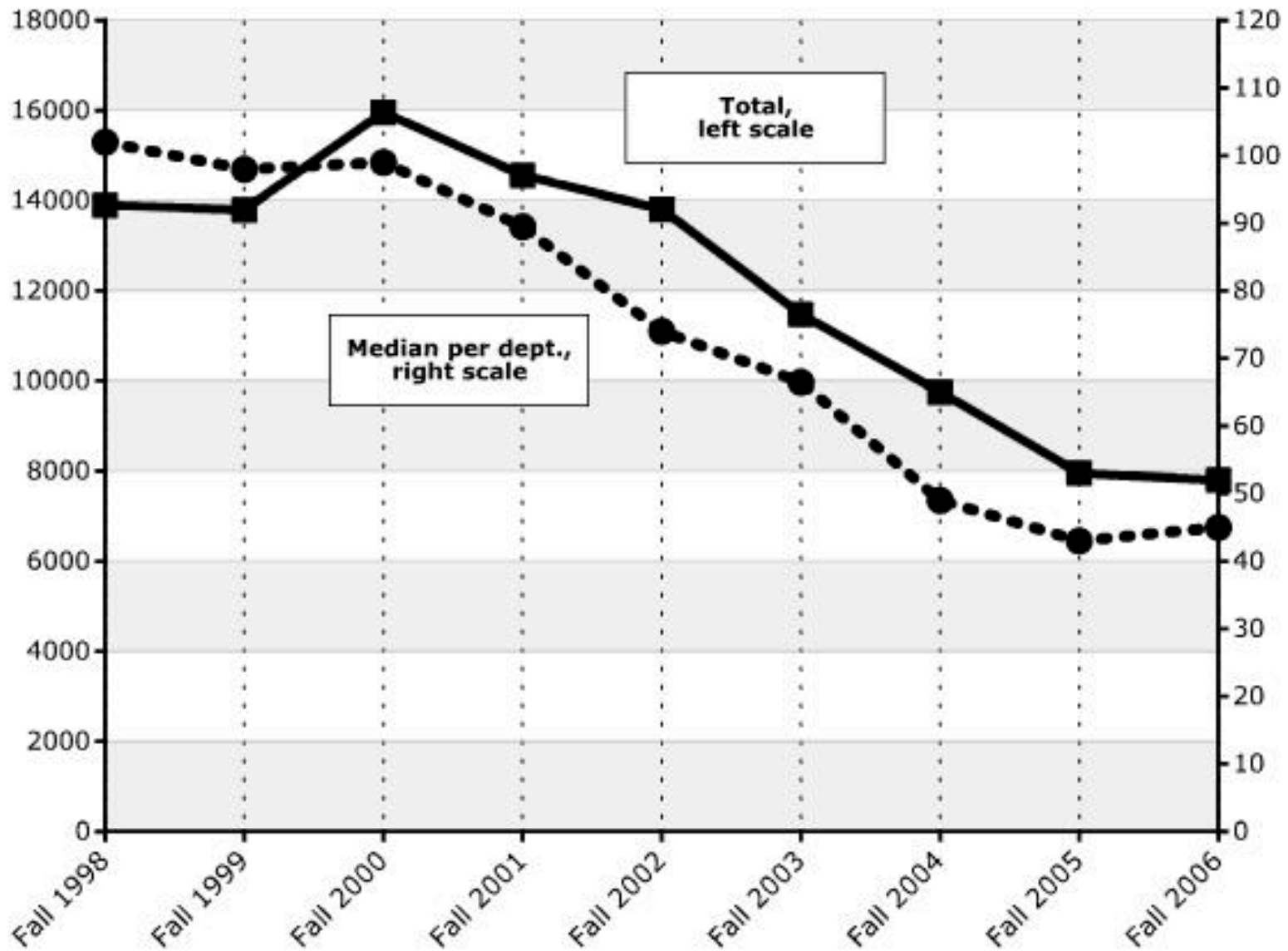
- Eric Grimson (MIT)
- Marc Snir (UIUC)
- Chris Stephenson (Computer Science Teachers Association)

# Setting the stage

- National decline in student interest in CS
  - Yet need for CS graduates is growing
- Losing ground to other engineering disciplines
- Problem is particularly acute for women and underrepresented minorities
- How can we counter trends and rekindle student interest in field before they get to college?

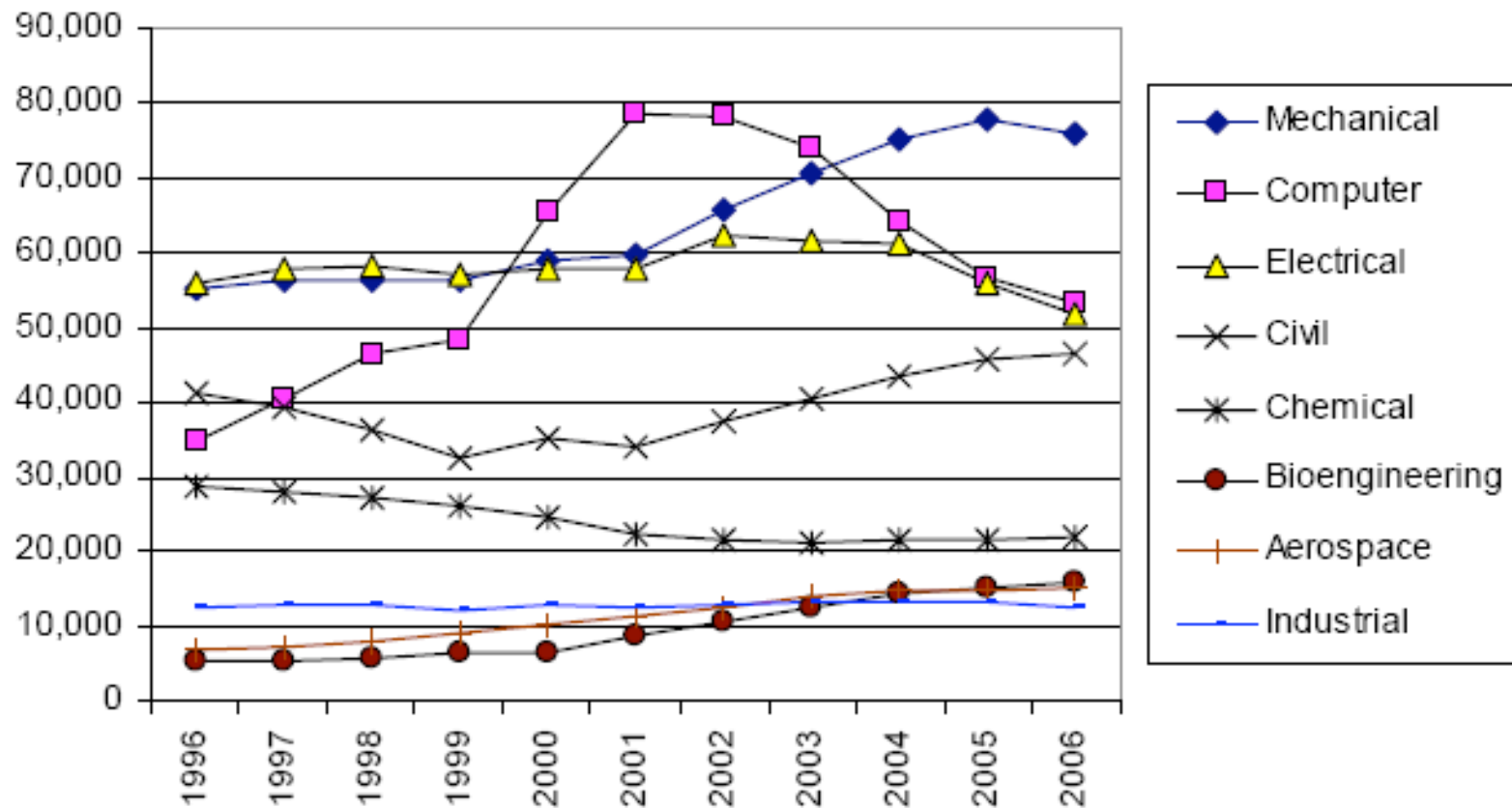
# Figure 1. Newly Declared CS Majors

Source: CRA Taulbee Survey



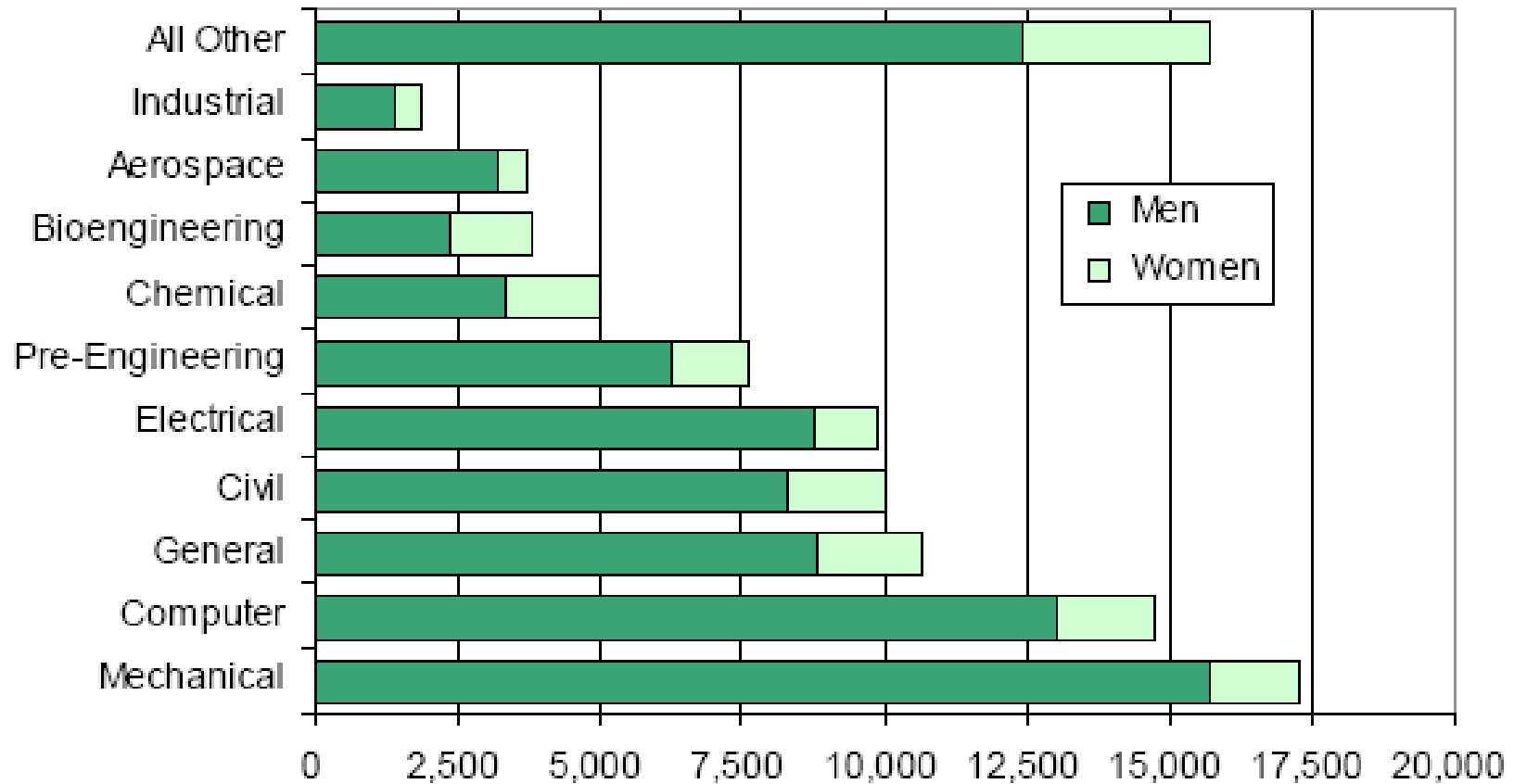
CRA: Jay Vegso

**Full-Time Undergraduate Engineering Enrollment  
by Major Discipline, Fall 1996 to Fall 2006**



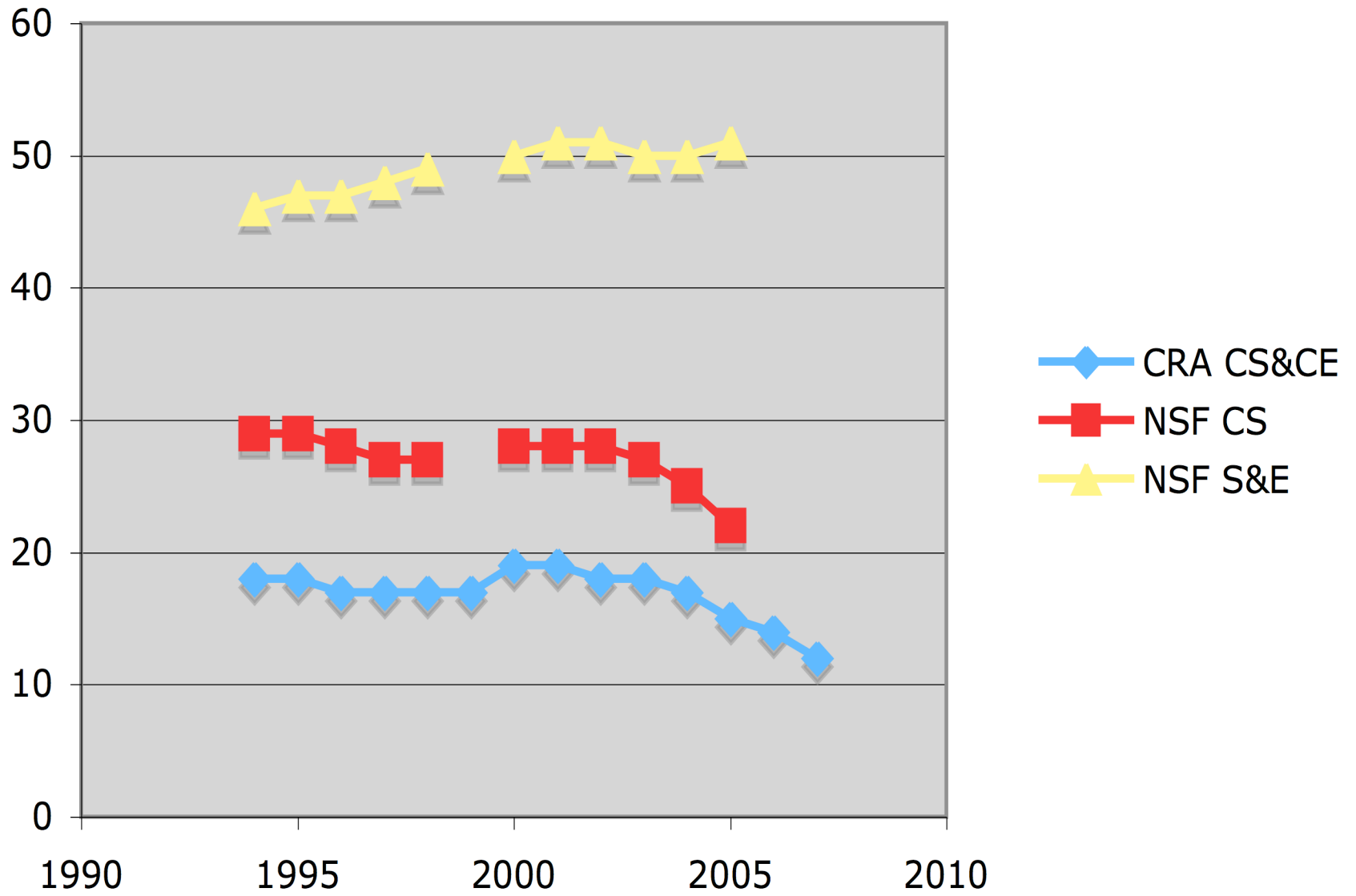
Source: CPST, data derived from Engineering Workforce Commission

### Full-Time, First-Year Engineering Enrollment in Major Disciplines, by Sex, Fall 2006

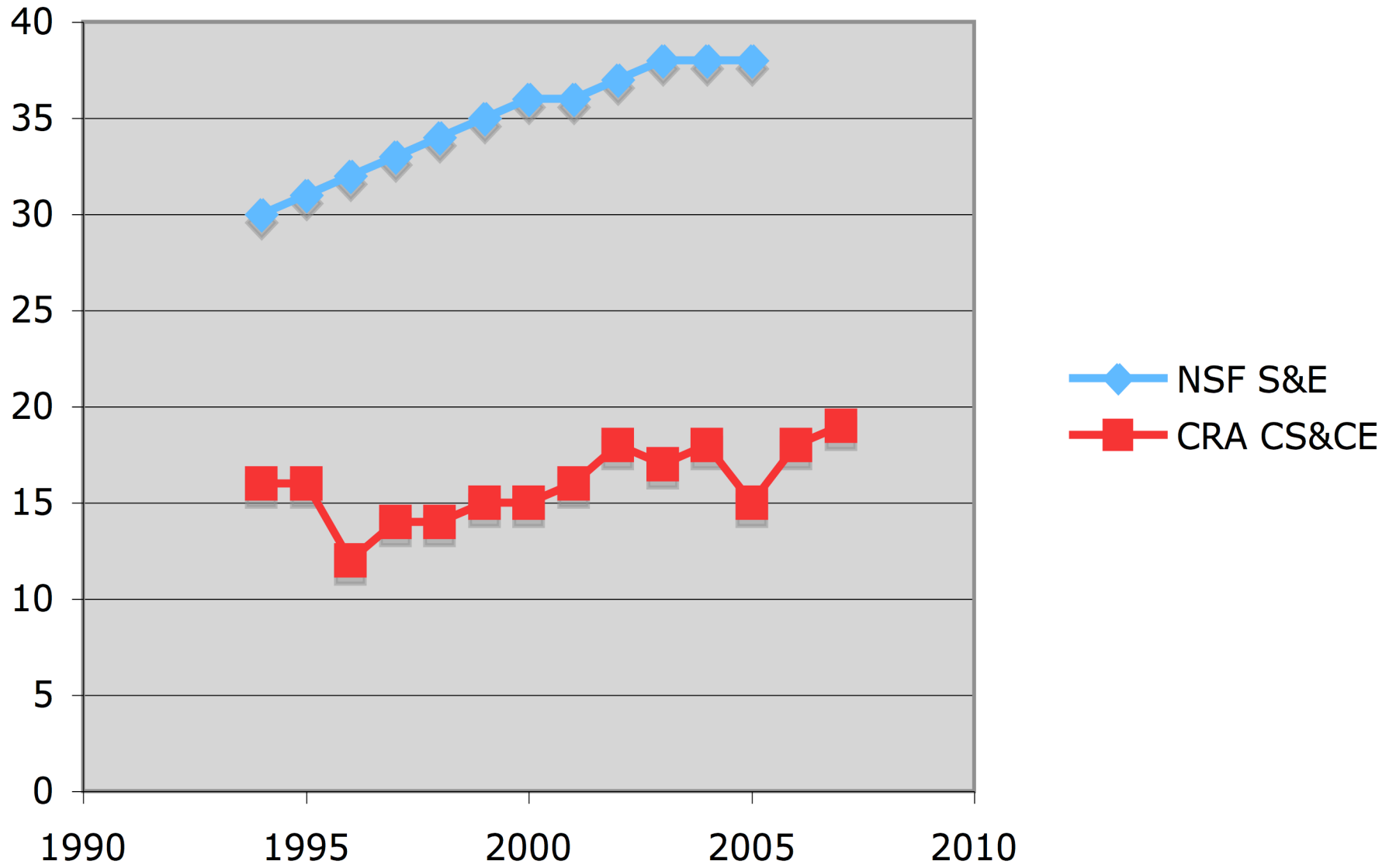


Source: CPST, data derived from EWC, *Engineering & Technology Enrollments, Fall 2006*

# % Bachelor degrees to women

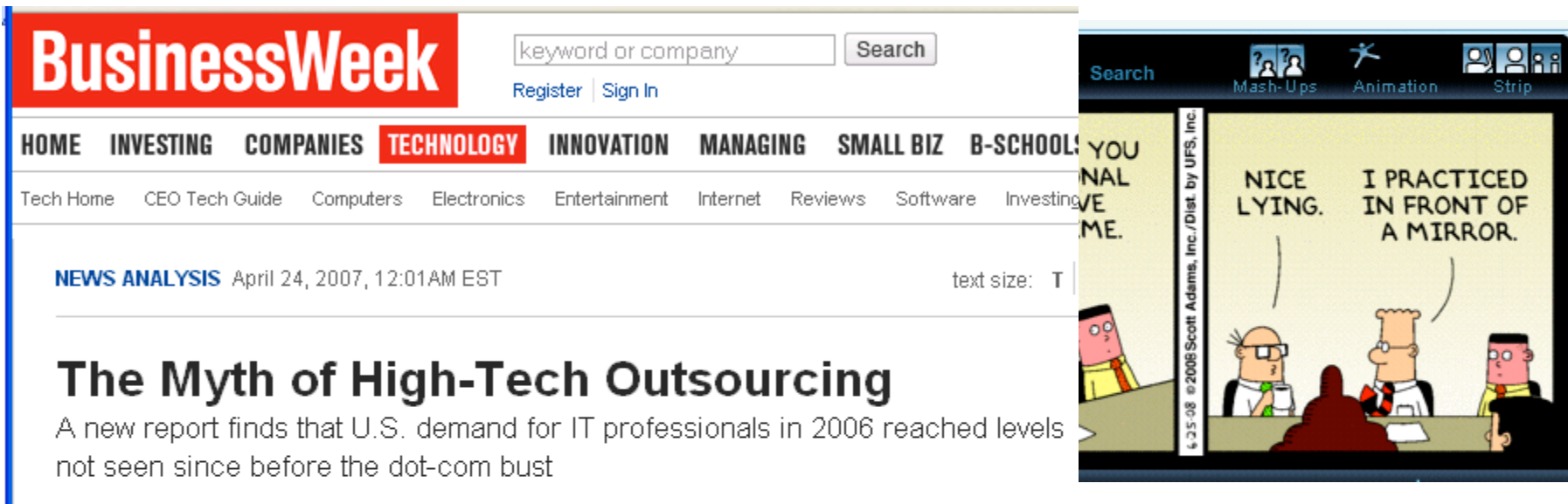


# % PhD degrees women



# Causes

- Image of field
- Misperception of job prospects
- Misperception of career opportunities
- Lack of role models
- Losing students early in process



The image shows a screenshot of the BusinessWeek website interface. The top navigation bar includes the BusinessWeek logo, a search box with the placeholder text "keyword or company", and links for "Register" and "Sign In". Below the navigation bar, there are several menu items: "HOME", "INVESTING", "COMPANIES", "TECHNOLOGY" (highlighted in red), "INNOVATION", "MANAGING", "SMALL BIZ", and "B-SCHOOL". Underneath these are sub-menu items: "Tech Home", "CEO Tech Guide", "Computers", "Electronics", "Entertainment", "Internet", "Reviews", "Software", and "Investing". The main content area features a "NEWS ANALYSIS" section dated "April 24, 2007, 12:01AM EST" with a "text size: T" option. The headline reads "The Myth of High-Tech Outsourcing" and the sub-headline states "A new report finds that U.S. demand for IT professionals in 2006 reached levels not seen since before the dot-com bust".

Overlaid on the right side of the screenshot is a cartoon strip. The cartoon shows three men in business suits sitting at a table. One man says, "NICE LYING." and another replies, "I PRACTICED IN FRONT OF A MIRROR." The cartoon is signed "© 2008 Scott Adams, Inc./Dist. by UFS, Inc." and includes navigation icons for "Search", "Mash-Ups", "Animation", and "Strip".



# ***Women's Technology Program***



***Sparking high school girls' interest in the fields  
of engineering and computer science***

7/20/08

## WTP was started in 2002 by MIT EECS students. Why?

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- Despite a 42% female MIT undergraduate population, EECS had only 20%
- Nationwide, the percent and number of women earning CS Bachelor's degrees had been in decline since the early 1990's
- Most high school girls with ***very high SAT math and science scores*** were still ***not*** choosing engineering majors, or applying to colleges with engineering departments.

# Pipeline Issues:

Jane Margolis and Allan Fisher, Carnegie-Mellon  
“Unlocking the Clubhouse: Women in Computing”

- negative stereotypes about the field
- lack of female role models
- lack of pre-college computing/engineering experience creates lack of confidence in EECS aptitude and ability

# WTP Goal:

- reach girls with demonstrated math and science talent
- before they make decisions about college and majors
- give them a taste of engineering and computers that will dispel the negative pipeline issues

# What is the WTP?

- Hands-On Courses
  - Computer Science
  - Electrical Engineering
  - Discrete Math
- Female MIT student staff
- Projects: Motor Building (Prof. Steve Leeb)
- Faculty & Industry Guest Speakers, Lab Tours
- Residential 4-week summer experience:
  - teamwork, problem-solving, informal learning, friends



**EECS is fun!**

# Computer Science

...thinking like a computer scientist



**Athena, Unix,  
Java Programming**

**Arrays**

**Algorithms**

**Recursion**

**Debugging**

**Problem Solving**

**Final projects:**

**Sketch Recognition**

**Uno-bots, GUIs**

# Electrical Engineering

**Current and Voltage**

**Circuits and Components**

**Digital Logic**

**Waveforms, Capacitance**

**Inductors & Filters**

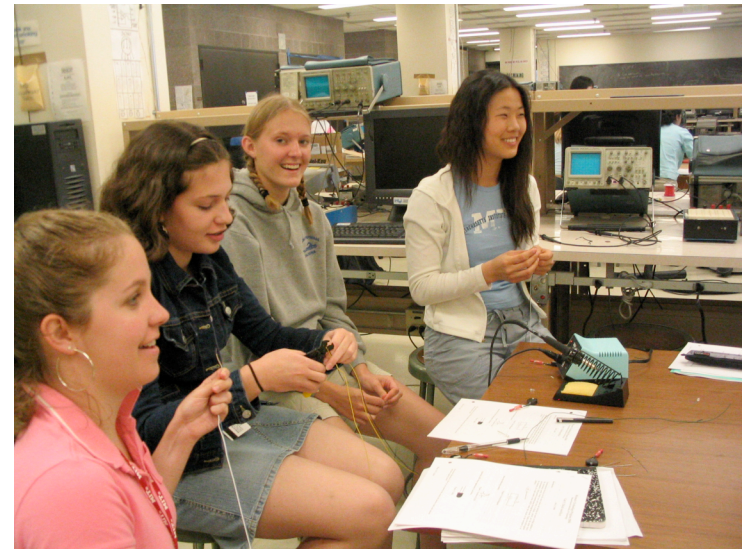
**Diodes, Transistors, Op-amps**

**Projects:**

**AM Radio**

**LED Jewelry**

**Random number generator**



# Discrete Math

Numbering systems

Binary Logic

Logic Proofs

Probability

Combinatorics

Algorithms

Proof by Induction and Recursion

Matrix Math

Student Presentations



# Motor Building



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16



# **WTP Staff (all female):**

## PhD students

- 3 Course Instructors (EE, CS, Math)
- 1 Residential Director

## Undergraduate students

- 9 Residential Tutors (3 each EE, CS, Math)
- 2 Residential Assistants (WTP alums/MIT frosh)

## Director

Cynthia Skier, MIT alumna SB '74, SM '81

# MIT Faculty Guest Speakers 2002-2005

Regina Barzilay

Eric Demaine

Mildred Dresselhaus

Polina Golland

Linda Griffith

Eric Grimson

Hugh Herr

Judy Hoyt

Leslie Kaelbling

Manoli Kellis

Steven Lee

Nancy Lynch

Daniela Rus

Joel Voldman

Victor Zue

Various EECS graduate students

Lab Tours: MTL fab, Broad Institute,  
3D Optics, RLE BioMems

# Funding Sources

- WTP student fees (\$3,000 but waive for 30%)
- EECS Department
- Dean of Engineering
- Individual Alumni Donors
- Corporate Sponsors

# Impact and Success: Short-term

## Intake and Exit Surveys 2005:

- **Increased interest in Engineering and CS majors**
  - **Engineering: 38% to 51%**      **CS: 9% to 17%**
- **Increased confidence in ability in EECS**
  - **EE: 55% increase**      **CS: 85% increase**

# **Impact and Success: Short-term**

## **Intake and Exit Surveys 2005:**

- **Change in attitudes towards EECS**
  - **88% : perception MORE POSITIVE after WTP**
  - **Not working in isolation**
  - **Benefits humanity**
  - **Not just for “nerds”**
  - **Offers good job opportunities**

# **Impact and Success: Long Term**

**WTP alumnae affirm the lasting impact of WTP on their current college pursuits and on their plans for the future.**

**Before WTP many would not have:**

- Majored in engineering or computer science**
- Applied to an engineering college**
- Considered applying to MIT**

# Statistics

- **Alumnae Summary Statistics as of 2008**

- 266 students have attended WTP-EECS over five summers
- The 40 summer 2008 students are currently seniors in high school, in the process of applying to college.
- Of the 226 old enough for college, 97 came to MIT (43%) -- 72 are currently attending, and 25 completed the SB degree
- 24 of the students are at Harvard
- 45 went to Stanford, Yale, Princeton, UPENN, Georgia Tech, Columbia, Cornell, Cal Tech, or Carnegie-Mellon

# Statistics (cont.)

- Declared Majors of the 177 college sophomores, juniors, seniors and Bachelor's Degree graduates:
  - 95 are majoring in a field of engineering or computer science (54%)
    - 56 are EE, CS, Artificial Intelligence, Operations Research or Applied Math majors (32%)
  - 18 are Mechanical Engineering majors (10%)
  - 47 are majoring in science or theoretical math (26%) -- many of these are pre-med
  - 18 are majoring in management or economics (10%)
  - 17 are majoring in humanities or architecture (5%)
  - 49 are unknown or undecided
- Of the 97 students at MIT:
  - 12 will enter as freshmen
  - 56 of the 83 with declared MIT majors are in one of the engineering departments at MIT (67%)
    - 25 are MIT EECS Course 6 majors; 15 are MIT Mechanical Engineering Course 2 majors



# Why students choose MIT

**“Before WTP I was unsure about what kinds of students went to MIT, and I was worried that I would not fit in and wasn’t smart enough... being at WTP convinced me there are plenty of people that I can relate to, and that I will not be at the bottom of the class.”**

**“WTP made my freshman year much easier, because I was already familiar with campus, and had a great group of friends.”**

**“WTP gave me the confidence I needed to convince myself that I could succeed in an engineering discipline... [and this helped me] search for research opportunities (UROPs).”**

## **How WTP influenced their majors:**

**“My major is Course 6, to which I was first introduced at WTP, otherwise I don’t know if I would have really considered it.”**

**“The hands-on projects made me realize that I should pursue engineering.”**

**“WTP definitely influenced my decision to choose EE...it was inspiring to learn about all of the creative applications it has, from the guest lectures we attended.”**

**“I wasn’t originally planning to go into any sort of science field, but the lectures on AI... sparked my interest in neuroscience. Having done WTP gave me the confidence to apply for a programming job this summer at my school’s [Oberlin’s] Computational Biomathematics Lab, and I got it! “**

# Impact

- “My experience at WTP definitely gave me confidence to apply to more top-tier schools. Because of the experience in EECS during WTP I’ve decided to go into Course 6 at MIT. Experimenting in EECS for a full month definitely boosted my confidence.” *Jessica Sundberg, Yardley, PA, WTP 2003, MIT Freshman Class of 2008.*
- “The positive experience I had at WTP greatly influenced my decision to attend MIT. The motor building workshop was awesome.” *Andrea Greb, Rochester Hills, MI, WTP 2003, MIT Freshman Class of 2008.*
- “Even more important than the information I took in during class was the spirit of innovation that abounded. We were encouraged to find new approaches, and saw professors researching at that very moment.” *Elena Glassman, Pipersville, PA, WTP 2002, MIT Freshman Class of 2008, 2003 Intel International Science and Engineering Fair Young Scientist Award winner.*

# *Women's Technology Program*



<http://wtp.mit.edu>