

Women and Information Technology (WIT):

*A Comparative Study of Young Women from Middle
Grades through High School and into Colleges
(NSF 020422)*

Sarah B. Berenson *Director of Center for Mathematics and Science
Education, and Professor of Mathematics Education*

Joan J. Michael *Professor of Psychology*

Mladen A. Vouk *Interim Dept Head and Professor of Computer
Science and Associate Vice Provost for Information
Technology*

North Carolina State University

Current Research Team

- Kera Z Bell (Ph.D. in CS, Mar 2006) – diversity consultant
- Kristy Boyer (Ph.D. student, CS) – data collection and analysis
- Rachael Dwight (Ph.D. student, CS) – data collection and analysis
- Maria Droujkova (Ph.D. in Math Ed, Mar 2004, postdoc) – data collection and analysis
- Kelli Slaten (Ph.D. student, Math Ed)
- P. Holt Wilson (Ph.D. student, Math Ed)
- James Maher (Consultant) - Statistics
- Lolita Trip (Consultant) – interviews, data collection
- Don McGurrin (Consultant) - data collection

Goals

- Investigation of factors and development of a model about young women's decisions to persist in advanced mathematics and computer science courses so as to prepare themselves for, and decide to make Information Technology (IT), their career.
- IT careers are defined as those requiring an electrical engineering, computer science, or Computer engineering bachelor's degree.
- Success factors rather than failure factors are examined.
- Seven year longitudinal study.
- Main intervention was in middle school and was to keep subjects on the fast math track.
- Information technology had no intervention – observational only.
- The main intervention was successful

Base Data

- Subjects
 - Tracking cca 200 high achieving young women, identified as talented in mathematics in middle school, who participated in the NSF Gender Equity project, [Girls on Track \(GoT\)](#), beginning in the Summer of 1999 (cohort1) through 2002 (cohort4).
- Demographics
 - At the start of the study, girls were in grades 7 and 8 and ages of the subject ranged from 11 – 13, with about 60% being Caucasian, about 30% African American, and about 10% Asian.
- On Track
 - Talented or high achieving middle school girls are defined as those girls electing and/or selected to take Algebra I in middle school. Staying “on track” is defined as taking calculus in high school.

[1] <http://ontrack.ncsu.edu> and references therein.

[2] NSF 9813902

Base Data (2)

Year	2005	2004	2003	2002	2001	2000	1999
Public Schools (40/n)	36	34	27	35	64	72	46
Private Schools (11/23)	6	2	3	7	5		
Home Schooled (2/2)	1			1			
Totals (53/339)	43	36	30	43	69	72	46

Base Data (3)

- Data in schools/campus
 - School, grade, Math courses and grades, EOC and EOG, Science courses and grades, Computer courses and grades, Computer test, Electives – tracking through middle and high schools (2000-2005)
 - College IT Freshmen and Sophomores
- Data through interviews
 - Camp interviews (45)
 - Spring 2004 individual interviews (39)
 - Summer 2004 (high school)(29 and 33)
 - January 2006 phone interviews (GoT cohorts FR/SO and high schools) (39)
 - March 2006 FR/SO at CSC/EE/ECE @NCSU (15)

Follow-up Interviews

- In depth interviews in the 2004 [e.g., WIT04, WIT05, Ber05a,b, Bar06]
 - They revealed that more than half of the girls had no image or had an incorrect image about “computer science” careers. Some perceived that “computer science” refers to use of tools such as spreadsheets and data bases rather than development of tools, and to repairing of hardware rather than the engineering of software and hardware.
 - The inventive, social and other benefits of IT careers appear to not have been well communicated to these girls.
- Phone interviews were also conducted in January 2006. Data from WIT student records and the interviews informed this study of 86 subjects who are 17-20 years old [Ber06].

Affinity to STEM Careers

On Track (60%)

	Physical Sciences, Engineering, Textiles	Life Sciences	Humanities
Pre-calc or Below	1	8	24
Calc1, Calc AB	5	9	5
AP Calc, Calc BC, Calc2, Calc3	11	9	10

STEM Careers (52%)

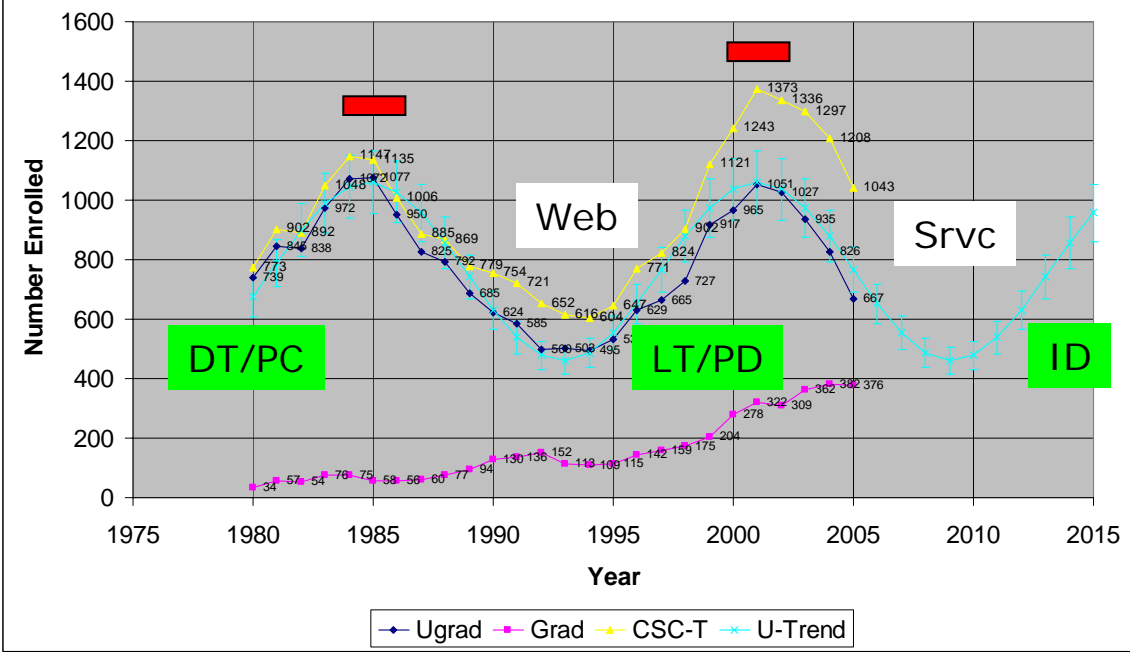
OnTrack and STEM (41%), predictive

Affinity to IT Careers

- 35 to 40% of Girls on Track participants were interested in IT when in middle school.
- Of more than 200 girls in our study, we have found only one who expresses an interest in an IT career in high school.
- Few elected computer science (CS) courses in high school.
 - Most of those taking CS girls noted the low numbers of girls in courses and were not interested in the content
 - Only one reported that she liked her CS class and enjoyed solving problems.
 - Only one student took 4 CS classes. Despite finding these courses easy, she is not considering a career in IT.
- None of the 86 girls in the January 2006 analysis are interested in majoring in computer science or physics.
- Impact?

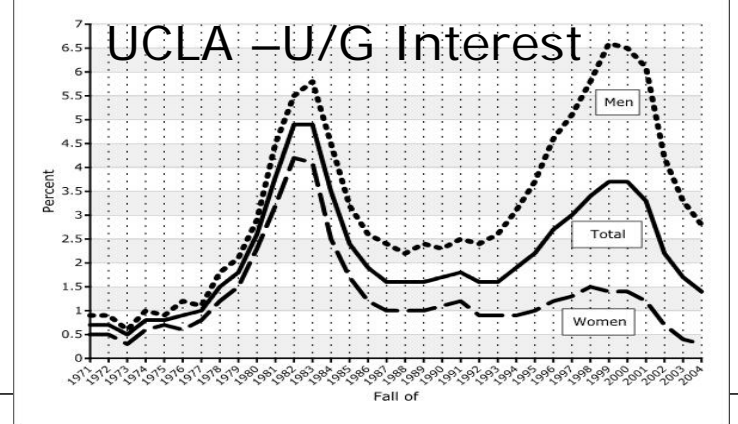
NCSU - Enrollments

CSC Students



Computer Science

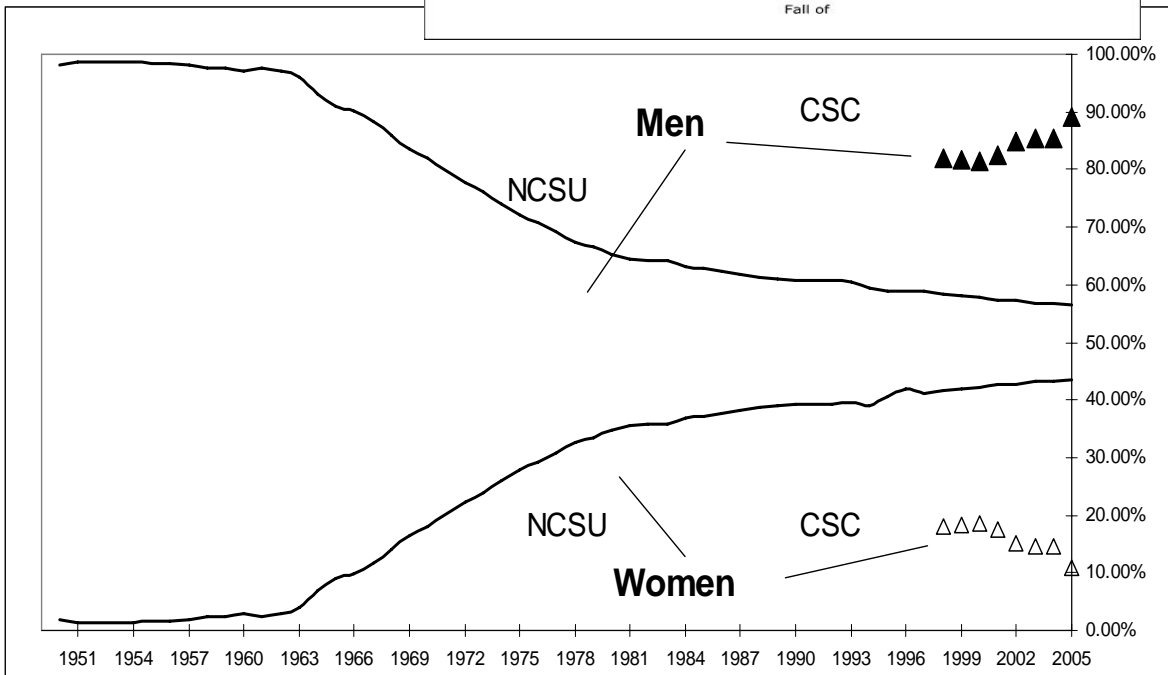
Figure 1. Computer Science Listed as Probable Major Among Incoming Freshmen
Source: HERI at UCLA



Difference between Grads and Undergrads (NCSU)

In 2005 enrollment of women down to 8% for undergrads and 16-17% for grads.

Apr 4, 2006/v4

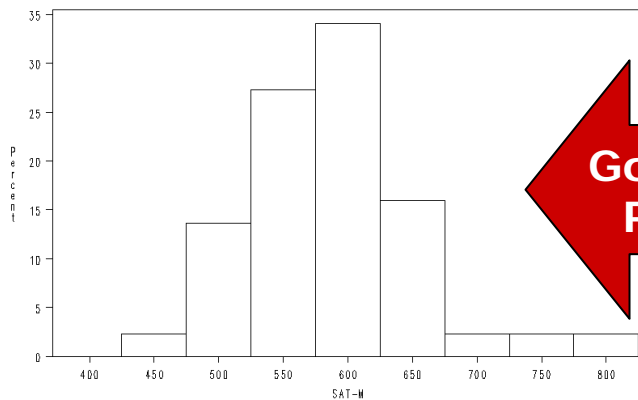


Differences from IT Majors

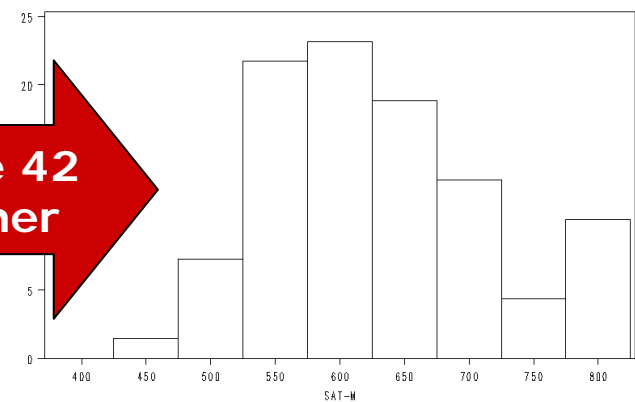
- Do the past experiences of female IT majors (CSC, CSU, CPE, CPU, EE, EEU) at NC State have identifiable common threads? For example, what factors motivated these women to choose IT?
- How do NC State women who are IT majors differ from the GoT women who overwhelmingly have not chosen IT majors?

A Preliminary Comparison: *NC State FR/SO Women IT Majors vs. GoT Women*

NC State SAT-Math (n=44)

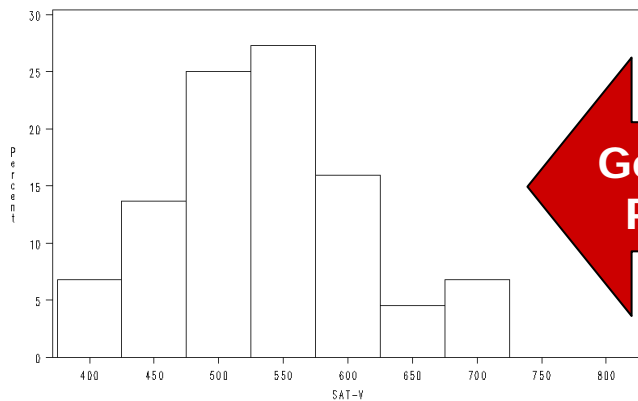


GoT SAT-Math (n=69)

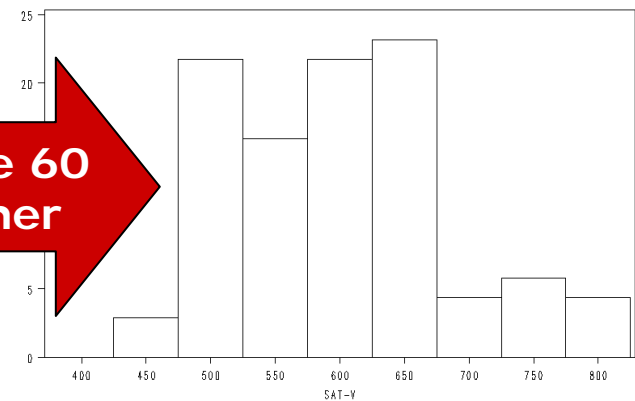


GoT Average 42 Points Higher

NC State SAT-Verbal (n=44)



GoT SAT-Verbal (n=69)



GoT Average 60 Points Higher

Early Interview Results

Sample of NC State Freshman and Sophomore Women (n=13)

Sample of GoT Women, 1999 and 2000 Cohorts (n=17)

Age: 18.9	↔	Age: 18.4
100% chose IT majors	↔	0% chose IT majors
SAT-Verbal: 536	↔	SAT-Verbal: 579
SAT-Math: 588	↔	SAT-Math: 621
46% were "on track" in HS math through graduation	↔	61% were "on track" in HS math through graduation

Further analysis will focus on qualitative differences between the two groups.

Conclusions & Actions

- STEM – good news
 - Data indicate that high school girls' choice of mathematics may be driven by career choice rather than success or failure in high school calculus.
 - Relationship between STEM career choices and high school calculus (predictive model)
- IT – bad news and need for action
 - National long-term advertising – CS is cool, “smart” is cool, ...
 - Changes in university Computer Science curriculum to
 - Make it more personal and hands-on
 - Connect material to end-use picture, social impact
 - Accommodate for Differences in K-12 Computer Experiences
 - Effect proper lateral entry?
 - K-12
 - Changes in IT curriculum and presentation in K-12, or at least 6-12.
 - Training of teachers and counselors in IT (requires taking away IT overhead, appropriate materials, team work, AP CSC needs to be done well and needs to count towards GPA and entry into universities,)
 - Promote general use of proven BPC methods (effective, scalable, replicable), e.g., pair support/activity, ...

