Stop The Female Brain Drain

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Overview

- Gender imbalance
- CS departments contribute
- Implications
Should We Pay Attention to Gender?

College-Bound CS Students

Female Portion of Intended CS Majors

Calculated with data from the College Board
CS Bucks The Trend

Women's Percent of Baccalaureates, 1985-2001

Data source: National Center for Education Statistics, IPEDS data
Low at Each Degree Level

Women in CS Degree Levels

Data source: IPEDS data
Why?

Social and Cultural Context

- Recruitment / Entry
- Retention / Persistence
- Advancement / Progression

Inborn Individual Traits
Differences in Math Foundation?

SAT-Takers, 2003

753718 male
652606 female

Honors Math Course

164998 male
134999 female
Differences in Math Foundation?

Years of H.S. Math

- Male: 3.8
- Female: 3.8

H.S. Math GPA

- Male: 3.09
- Female: 3.08
Mathematics SAT Score?

Intent and Tested Preparation

Gender Gap in Math SAT

Female % of intended CS Majors

Gender gap in Math SAT

Calculated with data from the College Board
Can’t Do the Math?

Women's Percent of Baccalaureates, 1985-2001

Mathematics
Computer Science

Data source: National Center for Education Statistics, IPEDS data
Stereotypes

• Masculine image
  – *I guess life just isn't fair until women grow chest hair, spit, chew, bench press 250 pounds, and write a computer program …* - Male Computer Consultant on ZDNN, 1998
Stereotyped Tasks ➔ Self-doubt

• Women CS majors less confident than even male non-majors (Beyer)

• Regardless of academic success

• Behavior conforms to noted stereotypes
Able Women Go Elsewhere

- She got an A in Computer Science [Intro] in the fall and an A+ in [Calculus I]. And do you know what she's taking this semester? English, Psychology, and Music. - CS Faculty Member
Two Nationwide Studies

• Undergraduate study of attrition
  – Cohoon, Cohoon, and Turner

• Graduate study of recruitment & retention
  – Cuny, Aspray, Cohoon, and Jesse

• Focus on department or program environment
Gendered Attrition from CS

Average Annual Undergraduate Attrition 1994/95 - 1999/00

% of declared CS major

Male students: 15%
Female students: 21%

Gender Gap: 6%
Departmental Variation

Gendered Attrition from the CS Major

- Study departments: 73
- Mean percentage point gender gap: -6 points
- Standard deviation: 6 points

Graph showing the distribution of percentage point gender gaps among departments.
Graduate Program Variation

Gender Gap in Thoughts of Leaving Graduate Program

$n=48$

mean = -5 points

stdd=23 points
Research Question

• What departmental characteristics are associated with the size of the gender gap in undergraduate attrition rates?
Methodology – Undergraduate Study

- Pilot study

- Interviews in 2001
  - 18 departments
  - 143 faculty and chair interviews
  - 178 undergraduate CS students
Methodology – Undergraduate Study

• Survey of 209 undergraduate CS departments in 2002
  – Largest and/or most prestigious undergraduate programs
  – Contiguous United States
  – Response rates
    • 76% chairpersons (159 chairs)
    • 68% faculty (1716 faculty)
Methodology – Undergraduate Study

• Official enrollment and disposition data
  – 73 departments
  – Calculate attrition/retention for men and women
Research Question – Graduate Study

• What departmental characteristics are associated with the size of the gender gap in students thoughts of leaving?
Methodology - Graduate Study

- Interviews and pretests
  - 3 programs
  - 1 national conference

- Survey
  - 49 programs
  - 2046 grad students (55% response rate)
  - 812 faculty (64% response rate)
  - 47 chair (96% response rate)
Attracting Women to Undergraduate CS

- Common attractions
- Women in particular
Common Attractions

- Positive prior experience
- Encouragement
- Math or logic confidence
- Enjoy programming
- Career rewards, flexibility, opportunity

I got addicted to that rush that you get with programming.
- Woman CS Major
Attractions for Women

• Communication or creative self-expression

• Path to a helping occupation

• Recruited by peers

• Defy gender stereotypes

I came here as a Psychology major, had never touched a computer, had no intention of ever touching a computer other than for word processing. And a friend convinced me to take Intro to Computers … for non-majors.

- Woman CS Major
Attraction to Graduate Study in CSE

Reasons for Pursuing CSE Graduate Degree

- Dependable employ: Women 3.51, Men 3.41
- Career: Women 3.62, Men 3.50
- Positive UG*: Women 3.65, Men 3.50
- Research**: Women 3.74, Men 3.94
- Interest/enjoy**: Women 4.06, Men 4.21

average rating of importance

- Women
- Men
Recruiters to Graduate Study

Influential People in Decision to Pursue a CSE Graduate Degree

- **Friends**
  - Women: 2.31
  - Men: 2.24

- **Significant Other**
  - Women: 2.64
  - Men: 2.19

- **Undergraduate instructor**
  - Women: 2.58
  - Men: 2.33

- **Undergraduate advisor**
  - Women: 2.64
  - Men: 2.53

- **Family**
  - Women: 2.80
  - Men: 2.67

average rating of importance
How Are Women Retained?

• Same as men for the most part
• Peers
  – Same-sex peer support
• Faculty
  – Encourage
  – Mentor for diversity
  – Expect work and focus
  – Adequate faculty
Leaving Under Same Conditions

Overall Attrition from CS

Male Rate of Attrition from CS

Female Rate of Attrition from CS

$r = .89$
Same-Sex Peers Retain Women

- Women help retain women undergraduates
Importance of Peer Support

• Most effective method of coping

  - *If I didn't have people here that I could come to and say, “What does this mean?” I don't think I would have stayed at all.* - Female CS Major

  - *You don't need a professor who's going to be like, ‘Don't you know this information? Didn't I teach it to you last week?’ You need a friend who says, ‘Don't worry. Together we'll work at it, and we'll learn it.”* - Male CS Major
Few Female Classmates

Gender Composition of Average Study Department

Male Enrollment

Female Enrollment 24%
Why Same Sex?

- Many women in CS comfortably rely on men
  - *I've always, ever since I was tiny, had guys for friends. ... You know - I'm getting married; I can't seem to find any bridesmaids.*
  - *My brother's my maid of honor.*
  - Female CS Majors in the same focus group
Why Same Sex?

- Some women prefer to rely on women
  - Easier to approach
  - Less concern about image
  - Less opportunity for misinterpretation

- Classmate support from men?
  - I got a 4.0 in my first semester and I had at least three separate guys, upon hearing about it, ask me if I did special favors for the professors. - Female CS major
Equal Access to Peer Support

- Gender balanced enrollments give women and men equal access to peer support
Faculty Help Retain Women

- Sufficient faculty
- Supportive faculty
- Mentoring
- Expect effort and academic focus
Supportive Faculty Retain Women

• Encouraging students
  - *It just takes me going to them and saying, "You do better than you think you do, so keep trying."* - Male CS Faculty Member
Encouraging Students to Persist

and Gendered Attrition Rate

\[ r = 0.34 \]

encourage men + women

gendered attrition rate
Mentoring Undergraduates

• Out-of-class relationship that includes
  – Involving individual students in professional activities
  – Offering personalized advice
  – Encouraging individual students
  – Helping students establish careers
Typical Mentoring

• 3 hours/week for undergraduates

• 3 hours/week for graduates

• 25% of faculty mentor to overcome under-representation

• 23% of faculty initiate mentoring
Two Types of Mentoring

• Support mentoring
  – Help navigate rules
  – Encourage shy but competent students
  – Specific positive feedback

• Research mentoring
  – Involve students in research
  – Publish with students
  – Inform students of research opportunities
  – Supervise non-course-related work
Advancing Students

- Support mentoring progression to graduate study
- Research mentoring quality of graduate program
Outcomes of Mentoring

• Advance to graduate study

• Retain women through diversity mentoring
Hard Work and Focus Don’t Hurt

• Undergraduate women succeed when faculty
  – Emphasize homework (average 7 hrs/week/course)
  – Expect focus

I was in a sorority, but I quit that because it was too much time commitment. ... I'm really trying to focus on school. – Woman CS Major
Explaining Gendered Attrition

- Adjusted $R^2 = .56$ for undergraduates
  - Concern over insufficient faculty
  - Faculty who encourage
  - Faculty expect academic focus
  - Mentor for diversity
  - Female percent of enrollment
  - Hours of homework
Leaving Graduate CSE Programs

Reasons for Thinking of Leaving CS Graduate Program

- To take a job: 60% All, 38% Men, 38% Women
- Personal, not related to dpt/program: 51% All, 48% Men, 48% Women
- Having to "prove yourself" in graduate work: 43% All, 38% Men, 36% Women
- Economic reasons: 38% All, 38% Men, 38% Women
- Not confident in own abilities: 49% All, 49% Men, 49% Women

* indicates statistical significance.
Leaving Graduate CSE Programs

Faculty Attitude and Student Thoughts Leaving for Low Confidence

$\text{diversity} = \text{lower academic quality}$

$r = -.30$

gender gap in thoughts of leaving bc confidence

diversity = lower academic quality
So What Do We Know?

• Clues about attracting women

• Generalizable results about retaining women

• Generalizable results about advancing students
  – Clues about advancing women
Implications

• Gender balance can be improved
  – Local environment can overcome inherent differences and prevailing stereotypes

• Opportunity for intervention
More Information

• [http://curry.edschool.virginia.edu/ITattrit](http://curry.edschool.virginia.edu/ITattrit)

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Variation in Undergraduate Programs

Female Portion of Enrollment, 1994-2000

- Number of study programs: 73
- Mean percentage female: 24%
- Standard deviation: 9 points
Variation in Graduate Programs

Female Portion of Graduate Enrollment, 2003

- n = 41 programs
- mean = 22% female
- stdd = 5 points