

ADDENDUM to 0305859 ITWF: Toward Gender Equitable Outcomes in IT Higher Education:
Beyond Computer Science

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Date: July 1, 2003

Conceptualization of the Study

This study will compare IT disciplines—Computer Science, Informatics, Information Science, Information Studies, and Instructional Technology—which we hypothesize are differentially receptive to female students due to differences in academic cultures. Based on female enrollments in those units at our home institution, Indiana University Bloomington, we have *prima facie* reason to believe that some disciplines are more attractive to female students than others. We selected these disciplines, in part, because we wished to represent a spectrum of "woman friendliness" in the sample, from low (hypothesized: Computer Science) to high (hypothesized: Instructional Technology). However, women's educational experiences in a discipline will not necessarily be positive just because that discipline has more women. Other factors, as identified in previous research on female students in computer science (e.g., Cohoon 2001; Margolis & Fischer 2002), may be equally or more important in creating a "woman friendly" environment. Moreover, such factors—including the availability of administrative support, mentoring programs, and student associations—vary from one institution to another within a single discipline.

In order to determine which factors most strongly favor attracting and retaining women students to study IT, the quantitative portion of the analysis will compare the presence or absence of a list of factors (see Table 1 in proposal)—measures of "woman friendliness" as found in previous research—with measures of student retention and success. In interpreting the results, we will relate student outcomes to the degree of "woman friendliness" of the unit, institution and/or discipline, as operationalized in Table 1. Student outcomes are the dependent variable, and environmental factors are the independent variables. This multivariate design will allow correlations to emerge between outcomes and individual environmental factors, as well as allow for broader interpretations in terms of the overall degree of "woman friendliness" of units, institutions and disciplines.

Categories of IT Disciplines

There are a variety of different names for information technology-related disciplines. Informatics, in particular, is a new discipline that is still in the process of defining its focus. In some universities, it is the outcome of a merger of Information Science with other disciplines; in others, it exists alongside Information Science. During pre-proposal preparation, we surveyed

over twenty institutions, and investigated the content of their IT-related programs, paying particular attention to Information Science/Studies and Informatics programs. In our study, we will use the names each institution has selected at face value, but we will group programs together according to similar substantive curriculum and content in analyzing the data.

Data Collection

We will make use of available data about the study institutions, provided such data are sufficiently current, so as not to duplicate previous data collection efforts. We have already used data from the individual institutions in selecting the schools and the appropriate relevant units. We intend to contact NCES about the availability of public IPEDS data for the proposed study institutions. These will be supplemented by institutional data provided by the universities themselves. The universities will also provide information about student enrollments and outcomes, and each study unit will provide names and email addresses of all undergraduate majors and graduate students enrolled in the target programs. This data collection will take place during the early stages of the study.

We will also collect data about the availability of resources hypothesized to contribute to the "woman friendliness" of the institutions and programs from a variety of sources, including the World Wide Web, on-campus observation, and direct questioning of administrators and faculty at the study universities. This data collection will take place primarily during the campus visits. For each discipline, relevant data will be collected periodically from workshops, conferences, and programs targeted to women, following initial collection of statistics on women in the discipline from national professional organizations.

In addition, we will collect data about the attitudes and experiences of students in the study programs. We will do this by two principal means: a Web-based survey administered to 5,000 students in the first semester of the study, and follow-up face-to-face interviews with approximately 155 students once a year over a period of three years. Also in the first semester, an estimated 440 faculty and administrators at the study institutions will be surveyed by telephone. The following table summarizes the collection schedule for the Web survey, phone survey, and face-to-face interview data.

Data Collection Schedule

<p>Phase 1-Year 1</p> <ul style="list-style-type: none"> ▪ September 2003 	<ul style="list-style-type: none"> ▪ Solicitation emails seeking participation in the survey sent to 5,000 students and a census of faculty, administrators and academic advisers on all campuses
<p>Phase 2-Year 1</p> <ul style="list-style-type: none"> ▪ October 2003 ▪ October/November 2003 ▪ November 2003 	<ul style="list-style-type: none"> ▪ Web-based surveys of 5,000 students (total) on all five campuses ▪ Telephone surveys of an estimated 440 faculty, administrators and academic advisers (total) on all five campuses ▪ Follow-up emails to web survey non-respondents
<p>Phase 3-Years 1, 2, and 3</p> <ul style="list-style-type: none"> ▪ February/March 2004 February /March 2005 April/May 2006 ▪ September/October 2004 September/October 2005 	<ul style="list-style-type: none"> ▪ In-depth face-to-face interviews of an average of 15 undergraduates, 8 master's and 8 Ph.D. students (total 155 students), and key faculty and administrators, at each of the five universities at three points in time ▪ Follow-up contacts through email/telephone with interview subjects

The co-PIs on the grant will design the Web survey and the interview questions,¹ in consultation with the Center for Survey Research (CSR), which will administer the surveys and assist in the preliminary analysis of the on-line survey data. We feel confident in CSR's expertise in the area of student surveys and interviews. The CSR has conducted the National Survey of Student Engagement for five years, for which it has obtained a response rate of 32% for a survey of unmotivated (randomly-sampled) students on a topic that is not highly salient. The NSSE is a survey of undergraduates; in the pilot year (1999), about 70 institutions participated. This year, 440 institutions are participating and approximately 350,000 students from the schools were randomly sampled.

¹ The design of the Web survey has been completed and was approved by the Indiana University Human Subjects Committee on June 30, 2003.

Justification for the Web-based Student Survey

The Web-based student survey is a critical component of our data collection methodology. The cross-sectional Web survey serves the function of collecting base-line attitudinal and experiential data for a broad population of students in the study units. Since the numbers of women in some IT programs studied will be small, the number of in-person interviews we can conduct will necessarily be limited. The Web survey will allow a broader population to be sampled (all students in the programs, rather than just female students; also students are more likely to answer a Web survey than agree to be personally interviewed). Triangulating the findings of the survey with the findings of the in-person interviews, the measures of "woman friendliness", and student outcomes will increase the validity and generalizability of the study's findings.

The survey will also provide information about differences across units, institutions and students that will be used to inform the selection of subjects for and design of the in-person interviews. This information, which is essential to the study design, would be expensive and time-consuming to collect by other means. Web-based surveys are less expensive than equivalent mail surveys, especially when large numbers of respondents are involved (Schleyer & Forrest 2000). Response speed is faster and response completeness is greater in Web surveys. Moreover, Web surveys are less error-prone (since data are entered into a database directly) and entail no data-entry costs (Schonlau et al. 2001). These factors, combined with the anonymity and convenience they afford subjects, make Web surveys a particularly efficacious means of data collection, especially for the target population of IT students, who already have a high level of comfort in using the Web.

Expected Response Rate

Response rates have been found to be roughly equal for Web surveys and mail surveys (around 52% in a study of business education professionals conducted by Truell et al. 2002). Schonlau et al. (2001) found that more women than men responded to a Web survey that related to women's interests. In as much as the present study focuses on issues affecting women in IT programs, such an effect may also be present in our data.

Moreover, previous research has found that response rates to Web surveys can be significantly increased by contacting sampled people before sending out the survey and by making follow-up contacts with non-respondents (Cook et al. 2000). In studies where email contact was made first followed by a Web survey, response rates of 78% (Zhang 2000) and 74% (Schleyer & Forrest 2000) were obtained.² In both cases, the respondents were professionals (researchers and dentists) who were computer-savvy and comfortable with electronic communication.

In light of the research on Web surveys, we (and the Center for Survey Research) believe that the estimated response rate of 30% initially provided by CSR underestimates the likely response, especially in as much as it assumes unmotivated (randomly-sampled) subjects (J. Kennedy, e-mail communication). We expect higher response rates for our survey, which

² In a similar study reported by Dillman (2000), "preselection" of respondents led to a response rate of 89%.

focuses on issues relevant to subjects' educational experiences, and involves computer-savvy IT students who are comfortable with electronic communication. These factors alone should push the survey response rate over 50% (as found, for example, by Truell et al. 2002). In addition, we plan to contact the subjects by email in advance, and follow up with non-respondents by email, to increase the response rate further. To save on costs, we plan to carry out this communication entirely electronically, rather than mailing out letters as stated in the original study proposal.

Controlling and Measuring Non-response Bias

Rosenthal and Rosnow (1991) suggest that increasing the effort to recruit non-respondents decreases non-response bias. We will direct efforts towards minimizing non-response, as indicated above. Specifically, following the recommendations of Linsky (1975) based on a survey of the literature on stimulating responses to questionnaires, we will employ the following techniques:

1. Enlisting the organization involved to sponsor the research, and including this information in the cover email.
2. Contacting potential respondents before they receive the questionnaire.
3. Using follow-ups or reminders in the form of emails to initial non-respondents.

To control for non-response bias in the survey data—that is, to determine the likelihood that non-participants would have provided significantly different responses from the participants—we will test the differences (using a t-test) between characteristics of respondents and non-respondents so that nature of bias, if any, can be interpreted intelligently (Rosenthal & Rosnow 1991). If no significant differences are found between these two groups, bias is interpreted to be minimal and insignificant. In order to obtain data on those who DO NOT respond to the questionnaire, two techniques will be utilized in our study:

1. We will begin with a database containing gender, year, and program information on each potential respondent, as provided by each study unit. We will then compare the characteristics of those who responded to the survey to those who did not respond.
2. We will follow up (via email) with a subset of non-respondents and ask them a few brief questions that will allow us to determine their possible responses. This will help us determine if their responses differ significantly from those who did respond.

Justification for Longitudinal Interview Design

We plan to interview selected subjects three times over a two-year period, at one-year intervals. Observation over multiple years is important because students' experiences change over time. Students who are initially enthusiastic about a program may encounter obstacles that lead them eventually to become discouraged and drop out. Conversely, feelings of discomfort

and doubt may diminish as a result of positive experience over time. The proposed study aims to identify which factors have these effects; longitudinal data will contribute crucially towards this goal. In this respect, the study design is modeled on the successful Carnegie Mellon study of women in computer science (Margolis & Fisher 2002), which interviewed students over a four-year period. As Blum (2001) notes, "By interviewing students [at regular intervals], the [Carnegie Mellon] researchers witnessed the ups and downs of their experiences and changes in attitude over time. Most importantly, they were able to identify crucial periods in students' attachments to the field, and factors that contributed to, or inhibited, their ability to succeed." Longitudinal interviews are also useful for collecting data about student experiences at different stages (e.g., sophomores vs. juniors vs. seniors) when the sample population is limited in size, as is the case for women in IT programs.

Some students out of the total 155 whom we plan to interview will change fields, drop out, or otherwise not persist in their original IT program of study. In such cases, we will attempt to maintain these students within the pool of interviewees, as they may be a useful resource for understanding reasons for student non-persistence.

Insuring Participation by Faculty, Administrators, and Advisors

Data for this study will be collected from five major research institutions. To secure the participation of faculty, administrators and advisors in the individual units, we have already e-mailed a preliminary request for participation in the proposed study to the heads (in most cases, the deans) of each unit in the five study institutions. A copy of the e-mail request is attached. Thus far, 15 out of the 20 units have responded affirmatively. A chart listing the confirmed participants is attached. Two other units are in the midst of a change in administration, and requested that we re-contact the new unit head after July 1, 2003. None of the units has thus far declined to participate in the study. We intend to follow up with a reminder email to those units that have not yet responded. We also plan to reconfirm formally each unit's willingness to participate when NSF funding for the study is approved. At that time, we will also contact a representative of the central administration of each university (e.g., the office of the Chancellor or Provost) to request permission to interview their staff and collect institutional data relevant to the study.

Dissemination of Results

1. Content-based Web-site: We will develop a resource website that will contain details of our study and its findings as well as links to other resources for people interested in IT higher education. The Web site will evolve over time. Initially, the website is proposed for the team, as we move through the three-phase program. It will later be made available to government, academia, and researchers interested in retention of women in IT-related programs and professions. At the end of the project term, the website will be universally accessible. Based on our findings, we will post implications for practice including recommendations for policy on the website.

2. Gender in IT Workshop: In order to initiate a conversation among the stakeholders regarding ways to promote recruitment, retention, and promotion of women in IT-related fields, we will organize a workshop to address these issues. Since the conclusions to this research will be of special importance to the universities that are the targets of the study, we plan to invite representatives from those schools to a conference to be held in Bloomington, Indiana at the end of the project. We will also invite a selection of faculty and administrators from teaching colleges where information technology courses are taught in a variety of departments.

3. Conference Presentations: We will present the findings at a panel of the CRA Conference at Snowbird. One of the investigators (Chris Ogan, Associate Dean for Graduate Studies and Research, School of Informatics) is in an administrative position and can arrange for us to attend this conference. For a broader audience, we will present our efforts as research in progress and our findings as research papers at ACM's Special Interest Group on Computer Personnel Research (SIGCPR).

4. Report: We will prepare a report containing the findings to be shared with the participants in the research as well as with professional associations.

5. Book: Upon conclusion of the study, we will write a book, to be published by an academic press, that will discuss the study itself, its findings, and recommendations for policy.

6. Journal Publications: We will prepare articles for publication in the education-oriented journals as well as the theoretical journals of the disciplines involved. Target journals are *Communications of the ACM*, *Computer Personnel Research*, *International Education Journal*, *International Journal of Technology*, and *Technology, Pedagogy and Education*.

Additional references:

- Blum, L. (2001). *Transforming the Culture of Computing at Carnegie Mellon*. <http://www-2.cs.cmu.edu/~lblum/PAPERS/TransformingTheCulture.pdf>
- Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in Web- or Internet-based surveys. *Educational and Psychological Measurement*, 60, 821-836.
- Dillman, D.A. (2000). *Mail and Internet Surveys, The Tailored Design Method*, 2nd ed., New York: John Wiley & Sons.
- Linsky, A. S. (1975). Stimulating response to mailed questionnaires: A review. *Public Opinion Quarterly*, 39, 83- 101
- Rosenthal, R., & Rosnow, R. (1991). *Essentials of Behavioral Research: Methods and Data Analysis*. New York, NY: McGraw Hill.
- Schleyer, T.K.L., & Forrest, J. L. (2000). Methods for the design and administration of Web-based surveys. *Journal of the American Medical Informatics Association*, 7, 416-425.
- Schonlau, M., Fricker, R. D. Jr., & Elliott, M. N. (2001). *Conducting Research Surveys via E-mail and the Web*. Santa Monica, CA: Rand Publications.
- Truell, A. D., Barlett, J. E. II, & Alexander, M. A. (2002). Response rate, speed, and completeness: A comparison of Internet-based and mail surveys. *Behavior Research Methods, Instruments, & Computers*, 34(1), 46-49.
- Zhang, Y. (2000). Using the Internet for survey research: A case study. *Journal of the American Society for Information Science*, 5, 57-68.