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ABSTRACT

Prior studies have examined diversity in information technology (IT), but few have tried to separate factors that specifically influence perceptions of IT work based on diversity. In this study, we analyzed these perceptions in relation to diversity, along with distinguishing factors influencing the choice of IT as a career. We administered the Diversity Perceptions Inventory (DPI) to a group of 162 undergraduate students at three institutions. A multivariate analysis of variance was used to compare differences in perceptions based on gender, ethnicity, age, and disability status. Although we found no significant differences between men and women, different age groups, work experience or disability status, we did find significant differences in perceptions based on ethnicity, as well as differences based on college major. We also found no significant interaction effects between gender and any of the other significant variables. Based on the results, we provide recommended actions and calls for future research related to diversity.

Key words:

Diversity, IT workforce, gender, sex, ethnicity, age, disability, DPI

INTRODUCTION

Today's businesses often choose to locate near concentrated pools of talented workers (Bruno, 1997a), just as businesses of the past located their facilities near their main factors of production of natural resources. Studies show that a community that is socially, culturally and ethnically diverse positively correlates to the area's success in technology (Florida and Gates, 2001). In addition, governmental regulations have focused attention on the importance of a diverse workforce. Diversity in the information technology (IT) workforce has multiple dimensions, from differences in perspectives to diversity in ethnicity[1], age, gender,[2] and disabilities. The effect of diversity on IT team processes and performance can and will have an impact on organizational outcomes (Ancona and Caldwell, 1992). While practitioners have to grapple with and balance the full spectrum of these issues on a daily basis, the academic community has focused on only some of the subsets of the IT diversity landscape, predominantly gender (Moody et al., 2003). This study seeks to expand our understanding of diversity in the IT literature by examining differences in groups based on age, disability status, ethnicity, as well as gender, and linking them to perceptions of specific dimensions of IT work.

We argue that diversity in the IT workforce is important for a number of reasons. Without women on IT development teams, technology pursuits may focus more on doing things faster, and less on doing new things that reflect alternative perspectives (Woodfield, 2002). Without disabled persons on IT teams, technology advances may evolve further away from accessibility, as with graphical user interfaces. Without age diversity, rich knowledge may be lost. Teams may find themselves re-inventing or even missing successful development methodologies without the inclusion of aging IT workers. Finally, diverse IT work teams provide cross-cultural perspectives necessary for supporting the growing number of global organizations.

[1] Ethnicity is defined as "Of or pertaining to a religious, racial, national, or cultural group" (American Heritage Dictionary, 1985, p. 467.)
[2] The terms "gender" and "sex" are used interchangeably and inconsistently in current literature. For purposes of this paper, the authors have chosen to use the term "gender" in order to connote both the biological and sociological aspects of diversity, as identified by Frank and Treichler (1989).

The Diversity Perceptions Inventory (DPI) is a previously validated instrument used to identify career influences (Woszczynski et al., 2003). The instrument provided us with a mechanism to examine the following main research question: Are there diversity-related differences in perceptions among those choosing an IT career?

BACKGROUND

The concept of a diverse workforce has been part of organizational employment practices since 1965 when Lyndon Johnson signed into law Executive Order 11246 (Crosby and Konrad, 2002). This law required that employers over a minimum size have an affirmative action plan that 1) monitors the number of its employees in protected classes, and 2) takes action regarding hiring and promoting those in the protected classes, should it find that the numbers do not match "the numbers of qualified people in the protected classes who are employable in those jobs" (Crosby and Konrad, 2002). Crosby and Konrad defined protected classes as women, African Americans, Hispanic Americans, Asian Americans, and Native Americans.

In addition, the Age Discrimination in Employment Act (ADEA) of 1967 prohibits discrimination in hiring and managing employees based on age. Areas covered include hiring, workforce reductions, promotions, firings, compensation, benefits, and job assignments, as well as education or training (EEOC, 2004). More recent legislation includes the Adults with Disabilities Act (ADA) of 1990 that prohibits workplace discrimination against disabled persons who are otherwise qualified. Giving equal access to persons with disabilities applies to the full career life cycle including hiring, workforce reductions, promotions, firings, compensation, benefits, job assignments and training, similar to the protections against age discrimination. In the next sections, we describe previous literature related to gender, ethnicity, age, and disability status in IT and then develop hypotheses for testing.

Gender Diversity in IT

The dearth of women in IT has been the subject of a large number of studies with emphasis on pipeline issues, particularly in undergraduate education. Since women choose and complete IT majors less frequently than their male counterparts (Camp, 1997), many studies have examined how to improve the recruitment and retention of women in IT majors. Others have examined women in technology from the standpoint of the glass ceiling and the work environment. For example, Smits and his colleagues (Smits et al., 1993) found gender and age differences in self-perceptions and in the importance of various job characteristics in entry-level IS professionals. It is well documented that the proportion of women in this field is small and shrinking, in spite of the fact that women dominate information-related careers (libraries, communications, journalism), and that at least fifty percent of Internet users are female (Friedman, 2000). Therefore, we propose:

Hypothesis 1: Women and men will have different perceptions of IT work.

Ethnic Diversity in IT

Ethnic minorities will grow much faster than the population as a whole in the United States in the next 25 years (Bloom, 1994/95). Empirical research in ethnicity and IT is limited. Studies of minorities and IT are more likely to focus on early access (or lack thereof) to computers at school and/or at home, on science and engineering rather than IT, and on prescriptions rather than empirical results. As with women, early in the educational pipeline many events influence minorities' interest and abilities in pursuing IT careers. The well-known "Digital Divide" refers to an apparently growing gap between those who have access to computers and the Internet, and those who, due to socioeconomic circumstances, do not. Unfortunately, lower socioeconomic status and limited access to computers often correlate with racial background (Attewell and Battle, 1999). Therefore, we propose:

Hypothesis 2: Different ethnicities will have different perceptions of IT work.

Age Diversity in IT

As with ethnicity, little research has considered age in relation to IT as a career. In one survey, 50% of employers perceived that older workers cannot perform as well as younger workers, and 30% of management trainers perceived older workers less

trainable (Reio et al., 1999).[3] Occupations paying high wages, requiring numerical aptitude, and using computers extensively, such as IT, include few older employees, few older new hires and limited openings (Hirsch et al., 2000). Age discrimination in IT apparently exists but may be based more on perception than reality. For example, a study of computer engineers found no difference in job performance as they aged (Underwood, 1986). A survey of *Network World* readers, however, indicated that the younger the age of the hiring manager, the less likely he or she would be to hire someone over 40 (Weinberg, 1998). Reducing possible discrimination against older IT workers could result in the ability of the IT industry to leverage a significant group of valuable IT human resources. Based on the literature suggesting the underrepresentation of older workers in IT, we propose:

Hypothesis 3a: Older IT professionals and younger IT professionals will have different perceptions of IT work.

Further, it follows that older workers are likely to have more work experience than younger workers. With increased experience and exposure to the workplace, the attitudes of IT workers may change. Therefore, we propose:

Hypothesis 3b: IT professionals with different levels of experience will have different perceptions of IT work.

Moreover, student class also implies a level of experience. That is, seniors are more experienced than juniors; juniors are more experienced than sophomores, and so on. Finally, we also suggest that majors closely related to technology will have different views of diversity in IT. That is, students who are actively engaged in taking IT-related classes will likely be more acutely aware of diversity – or the lack of diversity – than students in other majors. Therefore, we propose:

Hypothesis 3c: Different classes of students will have different perceptions of IT work.

Hypothesis 3d: Students with different majors will have different perceptions of IT work.

Diversity in Disability Status

A diverse IT workforce should also include those with various disabilities, yet people with disabilities are less likely to choose a career in IT than those without disabilities. Despite the fact that undergraduates with disabilities select majors in computer or information science in proportions similar to the population not having disabilities (Horn and Bobbitt, 1999), they do not have equal representation in the workforce. Approximately 35% of the employed work force is disabled (Braddock and Bachelder, 1994), but only 5% of computer scientists in the workforce are disabled. A mere 5.3% of Association of Computing Machinery (ACM) members identify themselves as disabled (Davies and Dipner, 1992). Therefore, we propose:

Hypothesis 4: Disabled workers will have different perceptions of IT work than non-disabled workers.

Interaction Effects

Further, some researchers have noted that examination of any single demographic variable may generate misleading results. Rather it is important to consider interactions, such as those between ethnicity and gender (Llewellyn and Usselman, 2001). Therefore, we propose:

Hypothesis 5a: Gender and ethnicity will interact to form different perceptions of IT work.
Hypothesis 5b: Gender and age will interact to form different perceptions of IT work.
Hypothesis 5c: Gender and work experience will interact to form different perceptions of IT work.
Hypothesis 5d: Gender and class will interact to form different perceptions of IT work.
Hypothesis 5e: Gender and major will interact to form different perceptions of IT work.
Hypothesis 5f: Gender and disability status will interact to form different perceptions of IT work.

One of the contributions of this study is that it extends previous research by considering diversity factors beyond gender. In addition, the analysis of the data has enriched our understanding of the complex factors that interact to produce outcomes.

[3] This study referred to workers in general, not specifically IT workers.

METHODOLOGY

Survey Administration

We administered the Diversity Perceptions Inventory (DPI) to a group of students taking IT-related courses. The DPI captures self-reported demographic data, as well as perceptions of factors related to preferences for IT work. We used the DPI to measure participant perceptions and diversity dimensions including gender, age, disability status (as registered with the universities), and ethnicity, in order to answer the following questions:

- What motivates someone to choose a career in IT?
- Is diversity perceived as a useful dimension of today's IT workforce?
- Is teamwork viewed as a useful and enjoyable component of today's workforce?
- What is the relationship, if any, between prior experiences and these perceptions?

The DPI includes 17 statements to which participants responded using a Likert scale from 1 = "strongly disagree" to 5 = "strongly agree." Demographic data and two open-ended questions were also included in the survey instrument.

Participants

The survey was administered to students from three universities in majors including computer science, information systems, accounting and others. Of these, about 100 were enrolled in a core IT subject, database systems. These participants included undergraduate students who had chosen IT majors, specifically majors in computer science (CS) or information systems (IS). About sixty accounting majors, enrolled in an accounting information systems course, also participated.

About two-thirds of IT participants were male. All accounting majors were male, due to the demographics of one of the participating institutions. Ethnic groups included White (65%), Black (14%), Asian (8%), Hispanic (5%) and Multi-cultural or other (8%). The majority (78%) were between the ages of 18 and 24, with approximately 15% in the age bracket of 25-34. Approximately 11% of participants reported having registered a disability status at their university.

RESULTS AND DISCUSSION

Factor loadings, coefficient alpha and other relevant statistics were calculated. Items loaded on expected factors. Scale reliability was assessed by calculating coefficient alpha. Reliability estimates were 0.81, 0.82, 0.63, and 0.68, for the Work-Life Balance, Teamwork Preferences, IT History, and Importance of Diversity scales, respectively. The four emerging factors included Work-Life Balance, Teamwork Preferences, IT History, and the Importance of Diversity. Work-life balance captures the essence of how family fits into an IT career decision, the importance of money in selecting a career, and the importance placed on work that is deemed useful to society. The specific statements were as follows:

- It is important to me that work in the IT field is useful to society.
- It is important to me that work in the IT field allows me time for family.
- Family obligations sometimes interfere with my school work.
- It is important to me that work in the IT field is well-paid.
- It is important to me that work in the IT field is interesting.

The second factor, Teamwork Preferences, is based on the following survey statements:

- I prefer to work in a group on school-related projects.
- I prefer to work alone on school projects.
- I prefer to work alone on work-related projects.
- I prefer to work in a group on work-related projects.

IT History, the third of the four factors, focuses on the student's prior experiences with computing, whether at home, work or school. The six statements comprising "IT History" are:

- I have experience using tools such as the Microsoft Office.
- I know a number of people working in the IT field.
- I prefer to let other students ask questions during class.
- I have a mentor (faculty, professional, or peer) in the IT field.
- I have work experience in the IT field.
- I have experience with computer games.

The Importance of Diversity is the fourth factor. Here the statements focus on the student's perception on the value of diversity, and their preferences for working in diverse groups. These items capture the individual's beliefs about the importance of diversity:

- I prefer to work with people of different backgrounds.
- Teams that have more diversity are more creative.

Multivariate Analysis of Variance (MANOVA)

Multivariate analysis of variance (MANOVA) was used to test the hypotheses. Table 1 summarizes the hypothesis testing results.

Hypothesis	Factor	Supported?
1 (Gender)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
2 (Ethnicity)	Work-Life Balance	Yes***
	Teamwork Preferences	No
	IT History	Yes***
	Importance of Diversity	Yes***
3a (Age)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
3b (Work experience)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
3c (Class)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
3d (Major)	Work-Life Balance	Yes***
	Teamwork Preferences	No
	IT History	Yes**
	Importance of Diversity	No
4 (Disability Status)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
5a (Gender*ethnicity)	Work-Life Balance	No
	Teamwork Preferences	No
	IT History	No
	Importance of Diversity	No
5b (Gender*age)	Not tested – no significant age effect	n/a
5c (Gender*work experience)	Not tested – no significant work experience effect	n/a
5d (Gender*class)	Not tested – no significant work	n/a

Hypothesis	Factor	Supported?
	experience effect	
5e (Gender*major)	Work-Life Balance Teamwork Preferences IT History Importance of Diversity	No No No No
5f (Gender*disability status)	Not tested – no significant work experience effect	n/a
*** $p < 0.01$ ** $p < 0.05$		

Table 1. Hypothesis Testing

Hypothesis 1 was not supported. MANOVA revealed that there were no significant differences in perceptions between men and women on any of the four identified factors. That is, men and women held similar beliefs about Work-Life Balance, Teamwork, and the Importance of Diversity. Likewise, women and men reported similar IT histories.

Hypothesis 2 was supported. Based on t-tests, different ethnic groups provided significantly different responses to statements regarding Work-Life balance, IT History, and the Importance of Diversity ($p<0.01$). See Table 2 for t-test results. Students with multi-cultural or other ethnicities differed from their Black and White peers. Multi-cultural students were more likely to choose IT as a career because of family or money considerations or because they felt the work would be useful to society. Results suggest that Blacks and Whites were not as strongly influenced by these factors. However, our sample included a small percentage of multi-cultural (about 8%) and Black students (about 14%), compared to White students (about 65%), and so, these results should be interpreted with caution.

Variable	Pairwise Comparison	Factor	Findings
Ethnicity	Multi-cultural – Black Multi-cultural – White	Work-Life Balance	Multi-cultural students were more likely to choose an IT career based on family considerations, money or the usefulness of IT to society than their Black or White counterparts.
Ethnicity	Asian-White	IT History	Asian students were more likely to have experience with computer tools or games, know people in the IT field or have mentors and have work experience than their White counterparts.
Ethnicity	Whites-Asians Whites-Blacks Whites-Hispanics	Importance of Diversity	Whites were more likely to prefer to work with people of different backgrounds and believe that diverse teams are more creative than their Asian, Black or Hispanic counterparts.
Major	Computer science-Business Information systems-Business	Work-Life Balance	Computer science and information systems majors were more likely to choose an IT career based on family considerations, money or the usefulness of IT society than Business majors.
Major	Business-Information systems	IT History	Business majors were more likely to have experience with computer tools or games, know people in the IT field or have mentors and work experience than information systems majors.

Table 2. Summary of Significant ($p<0.05$) Pairwise Comparisons

Results from t-tests suggest that Asian students were more likely than White students to have a diverse range of previous IT experience, including having mentors. These results indicate that Asians bring with them a wealth of previous IT experience, along with mentors to encourage them to enter the IT field. Other pairwise comparisons showed no significant differences between groups on the IT History factor.

For Factor 4, Importance of Diversity, t-tests revealed that Whites were more likely to believe that diversity is important than their Asian, Black or Hispanic counterparts. These results are encouraging, since they suggest that Whites – which make up a sizable percentage of IT workers – are open and welcoming to a diverse environment including many from underrepresented groups. Asian, Black and Hispanic students, however, were not as likely to prefer to work with people of different backgrounds and did not necessarily believe that diverse teams are more creative. Perhaps people in underrepresented groups are especially inclined to prefer work with people of similar backgrounds. This corresponds with previous literature reporting the tendency of women to seek and perform better when they have female mentors and teachers.

Hypotheses 3a, 3b and 3c were not supported, as shown in Table 1. There were no differences in perceptions of IT work by age, work experience or student classification. Hypothesis 3d was supported. That is, students with different majors had differing perspectives on Work-Life Balance ($p < 0.01$). T-test results reported in Table 2 suggest that computer science (CS) and information systems (IS) students differ from accounting students in this regard. CS and IS students were less influenced by family considerations, money, the work itself and the importance of IT to society than accounting students. Perhaps CS and IS students are motivated to pursue careers in IT for other reasons, such as a strong interest in computing coupled with aptitude. In contrast, accounting students would not move into the IT field unless they were properly motivated by money, the work itself or other considerations.

Oddly, accounting students reported a more diverse background of experience in IT than IS students ($p<0.05$), as shown in Table 2. The DPI collects some responses based on Microsoft Office and computer games. Accounting students are familiar with such tools, and tend to consider technology from a user's perspective. Therefore, they may feel they have a great deal of experience in IT, while IS students may recognize a broader range of IT and believe experience includes more than the use of tools. The IS students in this study were enrolled in a technically oriented program of study. Moreover, accounting students may have overestimated their IT experience, basing their responses on a limited set of tools to solve accounting problems.

Hypothesis 4 was not supported, as shown in Table 1. There were no significant differences in perceptions of IT work between disabled and non-disabled students. However, the study had a very small number of students who classified themselves as disabled. Perhaps we would find differences if we had a larger representation of disabled students. However, the percentage of disabled students in this sample was actually higher than the percentage reported in a study of ACM members, so we may have difficulty finding significantly larger groups.

Some previous work suggested interactions between ethnicity and gender (Llewellyn and Usselman, 2001). However, in this study, hypotheses 5a-5f were not supported, as shown in Table 1. Thus, our results do not support interaction between gender and ethnicity.

CONCLUSIONS

Using a sample of 162 students from three universities, we completed a multivariate analysis of variance (MANOVA) on responses to the Diversity Perceptions Inventory (DPI), in order to identify differences based on gender, ethnicity, age, disability status, university major and classification. Our results indicate differences between ethnic groups and among students with different majors, but we found no differences based on gender, disability status, age, work experience, or classification in the university. Moreover, we found no interaction effects between gender and ethnicity and gender and major.

While this initial analysis supports the usefulness of the DPI, further research is clearly warranted. Expanding the sample to include a more diverse age range, a greater number of disabled students and a more diverse group based on gender may lead to more compelling differences between groups. By further testing the DPI, researchers may be able to provide insights into how to reach underrepresented groups and encourage them to enter and succeed in the IT workforce, or indeed, if there are differences in perceptions between groups.

Implications

The dearth of diversity in the IT workforce is of concern to many people. Without diversity of vision and perspective, future innovations in technology and technology application are limited. Furthermore, large and important groups within society do not have full access to the intrinsic and extrinsic rewards of exciting careers in IT today.

The results from this study should prove useful to IT researchers, IT educators, IT recruiters, and IT managers. It extends prior work with important examination of ethnicity, as well as gender. Participants included students from many groups differing in gender, major, ethnicity, age and disability status. Although similar in many ways, there are important differences. CS and IS educators must be sensitive to ethnic, as well as gender issues when organizing teams and facilitating discussion in class. Awareness of ethnic differences should also affect an educator's ability to effectively advise and mentor IT students.

IT recruiters, IT managers, and other industry professionals who are concerned with the professional development of their IT workers must also become more knowledgeable about ethnic, as well as gender differences. Armed with such knowledge, they will be better able to facilitate and nurture qualified, contributing IT workers across a broad spectrum of perspectives.

Limitations and Future Research

This study takes a positivistic approach and will benefit from future work examining the issues through an interpretive study, perhaps. The positivist approach tends to suggest that there is an objective reality beyond human perception (Weber, 2004). The lens of an interpretive study may enrich our understanding of the results from this study and related ones. For example, this study considered ethnicity. It may be that culture, which is different from ethnicity, is also important. Social scientists are beginning to recognize the importance of distinguishing between the concepts of ethnicity (a self-reported variable related to nationality and ancestry) and culture (reflecting values, beliefs, and ways of processing one's experiences). Meaningful future research will require more refined operationalization of these constructs (Murray et al., 2001). It may also be helpful to consider contextual attributes.

Further, any study that uses self-reports to gather data runs the risk of common method variance (Woszczynski and Whitman, 2003). However, we did attempt to minimize some of the inherent problems with self-reports by allowing anonymous responses to reduce the impact of social desirability effects. Additionally, since we had a multi-factor solution, it did not appear that a common method was the predominant reason for the results obtained. Confirmatory factor analysis with explicit modeling of method bias should shed more light on this potential limitation.

Finally, our survey sample consisted of student participants. Although we believe that the results are generalizable to other populations, particularly workers in IT, future studies should include a wider range of respondents to make the results more generalizable. For example, our non-IT majors included only male accounting majors. This limits the interpretation of results related to chosen major and gender.

Previous work has examined the plight of women in IT, as well as the small and shrinking proportion of women in the field. It is clear that there is still much to learn. Has previous work focusing exclusively on women blinded us? Are there other aspects of the lack of diversity in the IT career pipeline that must be considered? Are cultural and ethnic differences as important as gender differences? For example, is the shortage of women in IT primarily a crisis for Western women? Will current off-shoring and out-sourcing of formerly US IT jobs change the questions, as well as the answers? Future research must seek to address these important aspects of diversity in the IT profession.

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