Journal of the Association for Information Systems (2021) **22**(1), 41-66
**doi:** 10.17705/1jais.00653

**RESEARCH ARTICLE**

**ISSN 1536-9323**

# Why Are Women Underrepresented in the American IT Industry? The Role of Explicit and Implicit Gender Identities

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**Abstract**

Gender inequality in the IT profession is an acute issue with major individual, societal, and national implications. In this study, we build on the *individual differences theory of gender and IT* and extend it to account for subconscious processes that may drive women away from IT university majors and IT career choices. We specifically theorize on how the asymmetric roles of explicit and implicit gender identity facets impact the major selection of men and women students and affect their decisions to pursue the IT profession. To do so, this study introduces the concept of implicit gender identity, defined as the degree to which men and women subconsciously, automatically, and uncontrollably associate themselves with the masculine and feminine gender groups, respectively. We obtained data from 185 pre-major selection university students by means of a survey and the Implicit Association Test. The findings revealed that implicit gender identity was a significant predictor of IT major and career choices for women but not for men university students. Explicit gender identity had no influence on IT major and career choices for men or women university students. Nevertheless, men's and women's IT major and career choices appear to be similarly influenced by normative pressures. IT skills and IT work experience also impact such choices. Ultimately, this study shows that implicit gender identity can be a factor that drives women university students away from the IT profession and contributes to the gender gap in the field.

**Keywords:** Gender Identity, Implicit, Explicit, Implicit Association Test, IT Profession, IT Major.

Manju Ahuja was the accepting senior editor. This research article was submitted on July 19, 2018 and underwent two revisions.

## 1 Introduction

Gender imbalance has long been an Achilles heel of the IT sector because women have been historically less likely to enter and more likely to leave the IT workforce (Adya, 2008; Armstrong et al., 2012; Kirton & Robertson, 2018; Ridley & Young, 2012; Trauth, Quesenberry, & Yeo, 2008b). Since closing this gap is important for national growth, innovation, and increased equality (Melguizo & Wolniak, 2012), factors influencing women's careers in the IT profession attracted significant attention from the research community (von Hellens, Trauth, & Fisher, 2012). As a result, a better understanding of gender issues in IT has been developed (Gallivan, 2013), including various issues such as career barriers (Michie & Nelson, 2006), cognitive challenges (Reid et al., 2010), and congruity between personal goals and gender roles (Diekman et al., 2010). Attempting to shrink this gender gap, a number of institutions have also launched successful educational programs aimed at attracting women IT students (Downey et al., 2016; Ferratt, Hall, & Kanet, 2016).

Initially, the key focus of research was on the differences between genders in terms of the likelihood of entering and remaining in the IT profession.

However, many studies have failed to explain IT career issues from the gender difference perspective. Igbaria and Siegel (1993) and Scholtz et al. (2019) showed that gender and IS career decisions are unrelated. Baroudi and Igbaria (1994-1995) reported that neither job satisfaction nor organizational commitment of IS workers are linked to gender. Crook et al. (1991) found no differences between the factors driving career decisions of men and women IT professionals and suggested looking beyond variables that match jobs to genders. Other scholars came to similar conclusions (Jiang & Klein, 1999). However, most of these studies considered gender as a binary variable (or used a dichotomous biological sex variable) and rarely looked beyond stereotypical gender definitions (Gallivan, 2013; Trauth, 2013).

In contrast, Klapwijk and Rommes (2009) observed that women represent a heterogeneous group and consequently pursue different values. They argued that instead of focusing on differences between the genders, researchers should concentrate on various differences among women and consider gender identity to be a core *continuous* variable that captures heterogeneity within a single gender. Similarly, based on a growing body of empirical evidence, Frieze et al. (2012), Trauth and Howcroft (2006), and Trauth (2006) argued that researchers should concentrate on diversity among women—not gender differences—because "gender difference approaches to the participation of women in computing have not provided adequate explanations for women's declining interest in computer science and related technical fields" (Frieze & Quesenberry, 2013, p. 445). Yeo and Grant (2019) also concluded that instead of distinguishing between the participation of men and women in the IT field, "it is worth investigating intra-gender differences within the workforce" (p. 19). Trauth and Quesenberry (2006) showed that "women vary with respect to factors that help to explain the underrepresentation of women in the IT profession" (p. 1768), and Trauth and Booth (2013) demonstrated the role of within-gender variation of various factors, including gender identity. Trauth et al. (2004) included gender identity in the individual differences theory of gender and IT as an important factor influencing women's decisions to pursue the IT profession. Such works have clearly demonstrated the role of between-individual differences in gender identity for determining women's IT career decisions.

We define gender identity as an individual's personal association with his or her gender group—the degree to which men and women identify themselves with masculine and feminine personality traits, attitudes, and behaviors, respectively (Boles & Tatr, 1982; Palan, 2001). Gender identity is assumed to be formed through both biological processes (i.e., nature—genes, hormones) (Swaab, 2004) and social and environmental processes (i.e., nurture—parents, peers, teachers, role models, the media, observation of others) (Bussey & Bandura, 1999; Eagly & Wood, 2013). Whereas gender identity remains stable for many people, it may also gradually change, especially under the influence of various socialization factors (Bussey, 2011). Gender identity is different from other gender-related constructs, such as gender stereotypes and gender attitudes (Wood & Eagly, 2009), and it is considered to be a continuous variable (Bem, 1974; Spence, Helmreich, & Stapp, 1975). This increases its explanatory power, accounts for intragroup differences, and makes it a good candidate for inclusion in causal models (e.g., see Ramkissoon & Nunkoo, 2012).

The present study focuses on the role of gender identity as an antecedent of women university students' decisions to major in IT disciplines and join the IT workforce upon graduation. It extends the abovementioned works, which have largely employed conscious and informed (explicit) self-reports of gender identity, by also tapping into students' subconscious (implicit) gender identity. To do so, two types of gender identity—explicit and implicit—are theoretically explored and empirically tested. Explicit gender identity is the degree to which men and women consciously associate themselves with masculine and feminine gender groups, respectively. It is the most commonly used category of gender identity measured by means of introspective self-reports.

Implicit gender identity, in contrast, is the extent to which men and women subconsciously, automatically, and uncontrollably associate themselves with the masculine and feminine gender groups, respectively. Because implicit gender identity may not be assessed by asking or observing respondents directly, in the present study, it was measured by means of the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998). This study hypothesized and empirically confirmed that women's but not men's implicit gender identity is related to their IT major and occupational choices. At the same time, both genders are influenced by social norms to the same degree. The presented theory provides a more comprehensive perspective of women's decisions to pursue IT careers, compared to studies focusing on explicit processes, extends the previous conscious view taken by prior research, and paves the way for future research and interventions aimed at closing the gender gap in the IT profession. The addition of a subconscious facet to existing theories is important, because the vast majority of decision-making processes are performed subconsciously (Joseph, 1992); thus, ignoring them can generate a very partial picture of people's behavior (De Houwer & Moors, 2012), presumably also regarding IT career choices.

# 2 Theoretical Background

## 2.1 Women in IT

The IT industry offers tremendous opportunities for women (Johnson, Kiser, & Kappelman, 2020). However, women currently constitute only a quarter of the entire US computing labor force (Ashcraft, McLain, & Eger, 2016). Women also represent one-third of all graduates of IT programs at US universities (Mandviwalla, Harold, & Boggi, 2017). Even though the number of women IT graduates has increased by 7% since 2013, this is insufficient to fulfill the growing demand for IT jobs, which may thus have devastating consequences for the entire IT industry. It is for this reason that IS researchers have explored ways to increase the enrollment of women in academic IT programs and retain them in the IT profession (Ahuja, 2002; Annabi & Lebovitz, 2018; Armstrong, Riemenschneider, & Giddens, 2018).

Traditionally, women have played a significant role in the development of computing. For example, Ada Lovelace (1815-1852), who worked with Charles Babbage on the development of the analytical engine, a proposed mechanical computer, is regarded as the world's first computer programmer (Hammerman & Russell, 2015). Grace Hopper wrote the first computer programming manual and invented the compiler and the COBOL programming language (Williams, 2012). In 1946, six women employees—Kathleen McNulty, Frances Bilas, Betty Jean Jennings, Ruth Lichterman, Elizabeth Snyder, and Marlyn Wescoff—wrote code for ENIAC, America's first electronic computer (Light, 1999). Margaret Hamilton and her team developed in-flight software that guided Apollo 11 on its 1969 lunar mission (Mindell, 2008). More recently, Frances E. Allen received the 2006 Turing Award from the Association of Computing Machinery (Steele, 2011). Sheryl Sandberg, the chief operating officer and a member of the board of directors of Facebook, is considered to be an architect of the company's advertising business model.

At the dawn of computing, women became very active participants in the IT field. At the end of the 1980s, they earned 37% of all computing degrees and constituted 38% of the entire US computing workforce (Misa, 2010). However, women have always remained underrepresented in the IT profession, and they have never reached an equal, 50/50 representation with men computing professionals. Thus, gender imbalance has always remained an issue for educators, recruiters, and human resource managers. One possible reason for this disparity is that computing has been stereotypically considered to be a masculine domain, which has likely deterred women college applicants, graduates, and job seekers from entering the IT profession (Kwan, Trauth, & Driehaus, 1985; Trauth et al., 2016). Even though women have always been hired for computing positions, it is possible that the perceived masculinity of the IT profession is a culprit responsible for reducing women's participation in the IT sector.

The present study focuses on such masculinity perceptions and, specifically, on the subconscious facets of these perceptions. It suggests and empirically demonstrates the importance of women's implicit gender identity in the context of IT education and occupation. This provides an innovative and useful account of the gender gap in the IT profession.

## 2.2 The Individual Differences Theory of Gender and IT

The literature pertaining to gender and the IT workforce encapsulates three main theories: the essentialist theory, the social construction theory, and the individual differences theory of gender and IT (Trauth & Quesenberry, 2007). *The essentialist theory* posits that men and women differ in their behavior because of inherent biological factors (Howcroft & Trauth, 2004; Marini, 1990). For example, men and women may deal with IT job stressors and rewards differently, in part due to endocrinological differences between the genders (Mather & Lighthall, 2012), differences in the way men and women process technology stressors (Turel, 2017; Turel & Gil-Or, 2019), and differences in the ways men and women embrace social norms (Chen et al., 2019).. *The social construction theory*, in contrast, emphasizes the effect of social and cultural contexts on gender differences (Lorber & Farrell, 1991). However, both theories consider gender to be a fixed variable and treat men and women as two distinct yet homogeneous groups (Trauth, 2002). Instead of exploring differences between men and women, the *individual differences theory of gender and IT* (Quesenberry & Trauth, 2012; Trauth, 2002; Trauth, Quesenberry, & Huang, 2008a, 2009) focuses on the diversity among women in terms of their IT career decisions. It concentrates on women's within-gender variation and considers women to be "individuals who possess different technical talents and inclinations and respond to the social shaping of gender in unique and particular ways" (Trauth et al., 2008a, p. 9). It identifies three high-level construct families—individual identity, individual influences, and environmental influences—which cumulatively explain why women enter and/or remain in the IT profession (see Table 1). As argued by Gorbacheva et al. (2019), the individual differences theory of gender and IT represents a fruitful research avenue for understanding gender imbalance in the IT profession.

**Table 1: The Individual Differences Theory of Gender and IT (Adapted from Quesenberry & Trauth, 2012)**

| Individual identity | Individual influences | Environmental influences |
|---|---|---|
| • Personal demographics (age, race, nationality, ethnicity, socioeconomic status)<br>• Career items (type of IT discipline)<br>• IT identity<br>• Gender identity *(implicit and explicit)* | • Personal characteristics (education, traits, abilities, aptitudes)<br>• Personal influences (mentors, role models, sponsors, exposure to computers, significant life experiences) | • Cultural influences (national, regional, and institutional attitudes and values)<br>• Economic influences (employment opportunities, economic conditions, cost of living)<br>• Policy influences (antidiscrimination policies)<br>• Infrastructure influences (child-care availability and support) |

The individual differences theory of gender and IT is based on an assumption that women perceive the barriers, stereotypes, and biases related to IT careers differently, and consequently experience the impact of such variables on their IT careers to different degrees. In other words, there are intragender differences that explain why women join or leave the IT profession, and this view has been supported in numerous follow-up studies (Adya, 2008; McGee, 2018; Trauth et al., 2008a, 2009). In particular, the theory emphasizes the role of gender identity because there is a "need to look beneath the surface of generalizations about different demographic groups" (Trauth, 2017, p. 13). In fact, the role of gender identity was emphasized in the first empirical work documenting the theory (Trauth et al., 2004). Because the IT profession is stereotypically perceived as masculine (Ahuja, 2002), it seems reasonable to assume that women who have developed a stronger masculine gender identity are more likely to join and stay in the computing field than those with a feminine gender identity. Thus, in order to understand the role of gender in the career decisions of university students, the present study focuses on the within-gender variation of gender identity (Trauth & Booth, 2013) as a factor that may impact the way that women respond to social messaging regarding the IT profession and account for differences in women's decisions in terms of pursuing IT careers. It extends the individual identity construct of the individual differences theory of gender and IT by proposing and empirically demonstrating the role of two different types of gender identity—explicit and implicit—in the context of career choices.

## 2.3 Explicit and Implicit Gender Identities

Prior IS research on the role of gender in IT has emphasized the importance of subconscious, implicit factors affecting women's gender identity (Trauth & Booth, 2013; Trauth & Quesenberry, 2006; Trauth et al., 2008b). However, the vast majority of IS researchers focus on people's explicit cognitive processes. During surveys or interviews, participants consciously access a self-concept pertaining to their gender identity in memory, deliberately retrieve the gender identity construct of which they are fully aware, and explicitly report it to the researchers. Thus, they provide a measure of their explicit gender identity that is always constructed by means of a conscious cognitive process when engaging in self-retrospective analysis.

However, explicit gender identity has several limitations. First, explicit constructs are context dependent (Bargh, 1994). For example, a woman IT manager may deliberately empathize and report a somewhat masculine gender identity when discussing her relationship with subordinates. In contrast, she may emphasize a feminine side of her gender identity in the context of her family. Second, people have different abilities for self-evaluation and self-retrospection (Devos & Banaji, 2003). For example, a woman may assume that she, similar to other women in her reference group, possesses only feminine characteristics, attitudes, and behaviors, without even trying to truly understand her gender identity. Others, however, may diligently evaluate themselves and, therefore, report a more accurate explicit measure.

Third, explicitly measured constructs are affected by social desirability bias (Crowne & Marlowe, 1960; Kwak, Holtkamp, & Kim, 2019; Podsakoff et al., 2003) because respondents may deliberately report an explicit gender identity that is considered appropriate. In some cases, respondents may not even be fully aware of the source of influence over their adjustment of explicitly reported factors. For example, a man IT employee may (knowingly or unknowingly) underreport feminine characteristics, assuming they are a sign of weakness.

Fourth, some LGBTQ (lesbian, gay, bisexual, transgender, queer, and questioning) people may provide inaccurate explicit measures of their gender identity because of perceived social stigma, automatically suppressed feelings, or lack of awareness of their true gender identity, because doing so requires access to and reporting highly sensitive

personal information. Even in North America and Europe, many people with homosexual or fluid sex orientations still feel uncomfortable openly revealing this to others (Moleiro & Pinto, 2015). In this case, their explicit gender identity may deviate from their "true" one, which may reduce the predictive power of models employing explicit gender identity constructs. Thus, it behooves gender researchers in the IT field to look beyond the commonly employed explicit gender identity measures and conceptualizations.

Implicit measures of sexual orientation, erotic preferences, sexual identity, and gender identity overcome the deficiency of explicit measures because such measurements are performed at the subconscious level (Gray & Snowden, 2009; Serenko & Turel, 2020; Snowden, Wichter, & Gray, 2008). For example, Snowden and Gray (2013) demonstrate that homosexual men and women show implicit sex-related appraisals of stimuli that are in line with their preferred sexual preferences, whereas explicit appraisals are prone to bias. Weinstein et al. (2012) show that there is a great degree of discrepancy between explicit and implicit measures of sexual identities of gay people, who tend to suppress their explicit sexual identity due to environmental factors. The ambivalence between explicit and implicit sexual orientation may lead to various negative consequences for LGBTQ people, including their well-being (Windsor-Shellard & Haddock, 2014). Overall, the studies above imply that implicit measures provided by both cis and LGBTQ people more accurately reflect their true gender identity than explicit measures.

Stoller (1968), who coined the term gender identity in his foundational work "Sex and Gender," indicated that one's awareness of his or her gender identity may be conscious or subconscious. Recent advances in psychology support the existence and importance of the subconscious facet. They demonstrate the existence and effects of implicit gender identity, defined as the degree to which men and women subconsciously, automatically, and uncontrollably associate themselves with masculine and feminine gender groups, respectively. It represents the strength of the association between the self and the masculine or feminine gender group, and this association exists beyond one's conscious awareness (Devos & Banaji, 2003). Similar to other implicit constructs (De Houwer & Moors, 2010; Gawronski & Bodenhausen, 2006; Greenwald & Banaji, 1995; Greenwald et al., 1998; Rydell et al., 2006), implicit gender identity forms through the pairing of a target construct (i.e., me) with its attributes (i.e., masculine vs. feminine characteristics). Table 2 outlines the differences between explicit and implicit gender identities. IS researchers have already documented the importance of implicit processes (Ortiz de Guinea & Markus, 2009; Ortiz de Guinea, Titah, & Léger, 2014; Riedl, Davis, & Hevner, 2014; Tams et al., 2014; Weinert, Maier, & Laumer, 2015), and the present investigation continues this important line of research.

**Table 2: Explicit vs. Implicit Gender Identity**

| | **Explicit gender identity** | **Implicit gender identity** |
|---|---|---|
| **Conceptual definition** | The degree to which men and women consciously associate themselves with masculine and feminine gender groups, respectively | The degree to which men and women subconsciously, automatically, and uncontrollably associate themselves with masculine and feminine gender groups, respectively |
| **Construction/retrieval process** | Deliberate | Automatic |
| **Context dependence** | Dependent | Independent |
| **Control and correction** | Easy | Extremely difficult |
| **Degree of awareness** | High | Low or none |
| **Development process** | Fast | Slow |
| **Influencing factors** | 1. Biological factors<br>2. Behavioral patterns in stable environments | 1. Biological factors<br>2. Behavioral patterns in stable and unstable environments, unique (single) emotional events, childhood experiences, deliberate thinking, reading, and active and passive socialization |
| **Measurement in self-reports** | Possible | Impossible |
| **Social desirability bias** | Present | Absent |
| **Temporal stability** | Low | High |

## 2.4 Hypotheses Development

Evidence suggests that self-identity can play an important role in the context of IT decision-making (Carter & Grover, 2015; Pan et al., 2017; Trauth, 2016). The individual differences theory of gender and IT further posits that individual identity is an important factor determining women's selection of an IT profession (Trauth et al., 2008a; Trauth et al., 2004). The present study extends this view by theorizing about and including explicit and implicit gender identities as predictors of the occupational choices of women university students. IT occupational choice is conceptualized in this study through two constructs: intentions to major in IT, and intentions to pursue a career in IT, representing short-term and long-term career plans, respectively. Intentions to major in IT capture a student's decision to select an IT-focused course bundle that would allow him or her to declare that his or her studies have a strong IT focus. Intentions to pursue a career in IT may be independent of one's university major (a student could major in general management but still wish to pursue a career in IT). It captures one's long-term plan to join the workforce in an IT-related role.

The effect of within-gender differences on women's IT career decisions may be explained from the perspective of the role congruity theory of prejudice (Eagly & Karau, 2002), which has been previously employed in conjunction with the individual differences theory of gender and IT (Joshi et al., 2013; McGee, 2018; Trauth et al., 2009). It posits that a woman's gender self-concept (i.e., gender identity) is often related to her occupational aspiration. [1] This happens because of a widespread belief that the characteristics of women as members of a social group, including their gender, should match the perceived requirements of the social roles in the context of a profession. Mismatch between the feminine characteristics and professional roles may generate social and personal discomfort expectations, which may deter women from making such choices (Riegle-Crumb et al., 2012). For example, firefighters, carpenters, and electricians are considered representatives of a masculine profession whereas nurses, elementary school teachers, and dental assistants are regarded as typical feminine occupations (White et al., 1989). For example, if a woman were to have prejudices about the gender associated with a prospective profession that is different from her own gender, she may experience a gender-role incongruity. To avoid a mental conflict, she may be likely to select a career path that is congruent with her gender identity (Joshi et al., 2013).

People make decisions on possible IT career paths early in life, generally in high school or during their early university years (Repenning, 2012). Because STEM (science, technology, engineering, and math) disciplines and the IT field are typically considered to be men-dominant professions and are associated with masculine attributes (Cundiff et al., 2013; Kiefer & Sekaquaptewa, 2007; Michie & Nelson, 2006; Smeding, 2012; Trauth et al., 2016), it is likely that women who have strong feminine gender identity would decide (consciously or subconsciously) that the IT profession is inappropriate for them. For example, Oswald (2008) showed that women who have strong prejudices about professions prefer feminine occupations. This line of reasoning may also apply in the university setting, regarding a major and a future profession selection.

With respect to women university students, the current study posits that the congruency between a student's explicit and/or implicit gender identity and job role-identity determines beliefs in her ability to excel in the IT profession, to ensure social acceptability and fit, and to achieve the expected level of competence. For example, a woman who very strongly associates with the feminine gender group may assume that she lacks the qualities required to successfully participate in "the masculine" IT profession and may expect to experience personal and social discomfort were she to choose this career path. Thus, the stronger the explicit and implicit feminine gender identities of a woman are, the less likely she is to select an IT major and pursue an IT career upon graduation. In contrast, a woman who weakly associates herself with the feminine gender group may assume that she possesses the masculine qualities presumed by the IT profession, that the IT career fits her, and that such choices will not lead to negative social and personal effects for her.

It is further noted that the effects of explicit and implicit gender identities may differ. On the one hand, both explicit and implicit gender identities can inform career reflection, gender-role congruency assessments, and the generation of discomfort expectations (though implicit gender identity does so subconsciously, see Joseph, 1992). On the other hand, due to conceptual differences between the identities (e.g., explicit gender identity is context-dependent and is influenced by social-desirability bias), each taps into distinct mental processes and differs in terms of its predictive power (Greenwald et al., 2009). Whereas the direction of

[1] In their work, Eagly & Karau (2002) often used the terms sex and gender interchangeably as synonyms, as was common in 2002. However, since the authors implied that gender is socially constructed because they used social role theory as a conceptual background for their work and they focused on the relationship between gender (i.e., not sex) roles and job roles, it was concluded that the role congruity theory adequately fits the context of the present study including the individual differences theory of gender and IT.

causal effects of explicit and implicit gender identities is expected to be the same, it is reasonable to hypothesize differences in the magnitude of respective causal relationships. For example, Allen et al. (2006) report differences in women's explicit and implicit responses regarding barriers they might face in the IT profession. White and White (2006) also document differences between explicit and implicit occupational gender stereotypes. Thus, explicit and implicit gender identities should be considered to be distinct constructs with similar-in-direction effects. Hence, we hypothesize:

**H1:** The explicit (feminine) gender identity of women university students will reduce their intentions to (a) major in IT, and (b) pursue a career in IT.

**H2:** The implicit (feminine) gender identity of women university students will reduce their intentions to (a) major in IT, and (b) pursue a career in IT.

Research shows that men and women may differ in their workplace cognitions, experiences, motivations, goals, and preferences (Joseph, Ang, & Slaughter, 2015; Kuhn & Joshi, 2009; Reid et al., 2010). Men also report having fewer professional career advancement barriers than women (Watts et al., 2015). Most importantly, men are unlikely to be influenced by their gender identity when selecting masculine occupations, including the IT profession. That is, gender identity plays a role when there is incongruence between one's gender and the role identity (women and the masculine IT profession), but it is not important when one's gender and role identity are congruent (men and the masculine IT profession) (Fischer & Arnold, 1994).

This asymmetry has been observed in multiple contexts (Simpson, 2004), including IT (Trauth et al., 2016). Applied to this study's context, men are likely aware (consciously and/or subconsciously) of their relatively strong gender-IT occupation match—they know that their gender is largely consistent with their own and others' prejudices about the IT profession. Thus, their masculine gender, by default, matches their gender perceptions associated with the masculine IT profession, regardless of their gender identity. Therefore, from a cognitive resources conservation perspective (Hobfoll, 1989), it is inefficient for men to heavily emphasize the explicit and implicit facets of this information and integrate them into their decision-making. Indeed, in an empirical study of US college students' major and career choices, DiDonato and Strough (2013) observed that preferences for gender-typed occupations predicted decisions of women students but not of men students. Overall, we posit that men are unlikely to integrate their explicit and implicit gender identities into their IT career choice decision-making. Thus, we hypothesize:

**H3:** The explicit (masculine) gender identity of men university students will not affect their intentions to (a) major in IT, and (b) pursue a career in IT.

**H4:** The implicit (masculine) gender identity of men university students will not affect their intentions to (a) major in IT, and (b) pursue a career in IT.

As per the individual differences theory of gender and IT (Quesenberry & Trauth, 2012; Trauth, 2002; Trauth et al., 2008a, 2009), women students' IT career choices are influenced not only by their gender identity but also by personal influences. Such influences often include normative pressures from peers, parents, mentors, role models, and educators (Adya & Kaiser, 2005). For example, if friends of a woman student choose an IT major, she may follow. The same applies to men students because their career choices can be also influenced by others. The role of normative pressures is consistent with the theory of planned behavior (Ajzen, 1991). Both women and men consider and often tend to comply with such pressures; this happens because conformity and a sense of in-group identity are important values that drive human behavior (Hogg & Terry, 2000). In contrast to gender-job role congruence/incongruence that is asymmetrically integrated into men's and women's career choices (H1-H4), social norms are expected to be integrated into the career choice decision-making processes of both genders. This is assumed, given that while social and personal risks and discomforts associated with gender-job role fit assessments vary between the genders, social and personal risks and discomforts associated with not complying with normative pressures should reasonably similarly affect both genders (Paschal & Steven, 1999). We hence hypothesize that:

**H5:** Social norms will increase women university students' intentions to (a) major in IT, and (b) pursue a career in IT.

**H6:** Social norms will increase men university students' intentions to (a) major in IT, and (b) pursue a career in IT.

# 3 Methodology

## 3.1 Sample

We invited 245 business students at a US university who had not yet declared their university major to participate in the study in exchange for course extra credit. We obtained 185 usable records (76% response rate); 53% and 47% of respondents were women and men students, respectively. On average, they were 23.56 years old, ranging from 19 to 42 years old. Their IT work experience ranged from none to 16 years, with an average of 1.51 years. Analyses of variance indicated that men and women did not differ in their IT skill levels

($M_{men}$ = 51.71, $M_{women}$ = 51.65, $p$ = 0.95), age ($M_{men}$ = 23.46, $M_{women}$ = 23.67, $p$ = 0.72) and IT work experience ($M_{men}$ = 1.39, $M_{women}$ = 1.65, $p$ = 0.47). Social desirability bias was stronger in the women subsample ($M_{men}$ = 5.59, $M_{women}$ = 6.37, $p < 0.05$).

While no race, ethnicity, biological sex at birth, and sexual orientation data were collected, the study was conducted in a Hispanic-oriented institution with the following approximate racial composition: 40% Hispanic/Latinx; 28% Asian; 2% Black/African American; and 30% White. Assuming sexual orientation and gender-misalignment compositions similar to those in the US, it is reasonable to expect that the sample contained 4.5% LGBTQ people including less than 0.5% transgender (typically estimated at 0.3%) respondents.

## 3.2 Explicit Measures

The explicit gender identity scale is based on the frequently used gender identity items employed by Cundiff et al. (2013), Ebert et al. (2014), and Kiefer and Sekaquaptewa (2007). The three bipolar measurement items are: woman vs. man; she vs. he; and her vs. his, and the scale was adjusted so that the highest score corresponded to a match between the respondent's self-reported gender identity and his or her gender (e.g., see Greenwald & Farnham, 2000). For this, men and women respondents were automatically redirected to different versions of the survey. Items measuring social norms were adapted from Morris & Venkatesh (2000). Items for intentions to major in IT and pursue an IT career are based on a behavioral intentions scale of Venkatesh et al. (2003). Social desirability bias was measured with the Reynolds (1982) instrument. Control variables include age, IT skills, and IT work experience. Age may be important here because gender and job role perceptions may evolve with age (Twenge, 1997). IT skills and IT work experience may also be important as they can increase motivation and reduce barriers for choosing IT majors and careers (Quesenberry & Trauth, 2012; Trauth et al., 2016). We captured age and years of IT work experience by using open-ended numerical response questions. IT skills were measured with nine items adapted from He and Freeman (2010), with each item representing one specific IT-related domain. The sum of the scores therefore captures an individual's IT skill score across IT types, applications, and knowledge domains. The IT skills scores range from 20 to 63, with a mean of 51.63. Consistent with previous gender identity studies (Cundiff et al., 2013; Lane, Goh, & Driver-Linn, 2012), respondents were asked to indicate their gender as man, woman, or other (please specify) because they needed to be classified into one of two groups (men vs. women) for hypothesis testing. We pilot-tested the survey with 50 students; all reflective multi-item scales were determined to be valid and reliable (Cronbach's alphas > 0.79). The survey items are presented in Appendix A.

## 3.3 Implicit Measures

We measured implicit gender identity by administering the Implicit Association Test (IAT) (Greenwald et al., 1998). It is considered to be a valid approach for the measurement of various implicit constructs (Greenwald & Banaji, 2017; Serenko & Turel, 2020; Turel & Serenko, 2020; Serenko & Turel, 2019), including gender identity (Cundiff et al., 2013; Nosek, Greenwald, & Banaji, 2005; Nosek & Smyth, 2011). The IAT measures the strength of the association between a target construct (Me) and an attribute (Gender). Note that "Others" is used as a contrast construct, which is a requirement for the administration of the IAT. The target construct, the contrast construct, and the attribute were operationalized with representative stimuli adapted from Lane et al. (2012), Cundiff et al. (2013), Ebert et al. (2014), and Kiefer and Sekaquaptewa (2007). During the test, the target construct, the contrast construct, and the attribute appeared in the top right and left corners of the computer screen. Stimuli appeared randomly in the center (but the same stimulus may not appear twice in a row), and the subjects were required to sort them into appropriate categories as quickly as possible while minimizing the number of mistakes. They used the "E" key to sort the stimuli to the left, and the "I" key to sort the stimuli to the right.

The IAT is based on the assumption that the strength of the association between a target construct and an attribute directly influences performance. When the target construct-attribute association is congruent, people perform classification tasks more quickly and accurately than in situations where the association is incongruent. The subject's IAT score (referred to as the *D* statistic) was determined by the difference in performance (task completion and error rate)—the larger the difference in performance, the stronger the subject subconsciously identifies him- or herself with his or her gender. The IAT consists of five blocks: three are for practice (Blocks 1, 2, and 4—but the subjects do not know this) and two are for scoring (Blocks 3 and 5). The pairs are congruent in Block 3 and incongruent in Block 5. The IAT score is calculated based on the formula of Greenwald et al. (2003) (i.e., performance in Block 5 minus performance in Block 3). For more information about the IAT, see Greenwald et al. (1998) and Serenko and Turel (2020).

Appendix B presents the IAT design. The *Free*IAT software tool was used to administer the test (Meade, 2009). It reports two scores (one based on the first half of the stimuli and the second based on the second half of the stimuli) that were used to operationalize the implicit gender identity construct.

We designed four versions of the IAT, assigning constructs and attributes to different keys. Depending

on the IAT version and the subject's gender (which was reported in the survey), the IAT scores were converted so that the resulting score was consistent with the subject's self-reported gender and, therefore, reflected his or her implicit gender identity (the higher the score, the stronger one's implicit gender identity). Approximately half of the subjects completed an online survey followed by the IAT, and half did this in reverse order. Thus, there were eight versions of the experimental procedure, and our procedures minimized order-effect bias.

# 4 Results

## 4.1 Model Estimation

Table 3 outlines reliability indices and construct correlations. It provides initial evidence for construct reliability and validity. The square root of the average variance extracted, Cronbach's alpha, and composite reliability values exceeded a recommended cut-off of 0.5, 0.7, and 0.7, respectively (Fornell & Larcker, 1981; Nunnally & Bernstein, 1994). Convergent validity and discriminant validity were further supported with a confirmatory factor analysis (CFA) model estimated in AMOS 25. The model produced the expected loading pattern and adequate fit indices based on cutoffs suggested by Hu and Bentler (1999) ($\chi^2(168) = 243.2$; $\chi^2/DF=1.44$, CFI = 0.99; IFI = 0.99; TLI=0.98; RMSEA = 0.034).

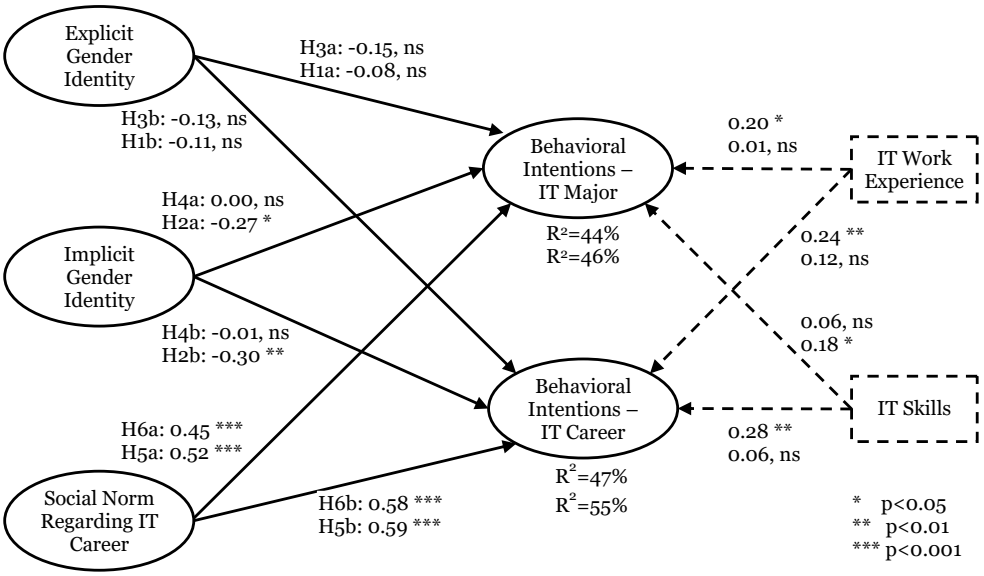
Given the fit of the CFA model, we proceeded with structural model estimation with the multigroup analysis facilities of AMOS 25. These facilities estimated the unconstrained model using all records and then separately estimated model parameters with records from women and records from men in the sample; see the detailed explanation of AMOS multigroup analysis in Byrne (2004). The structural model included all control variables (age, IT skills, IT work experience, and social desirability bias). The model presented good fit ($\chi^2(264) = 329.7$; $\chi^2/DF=1.25$, CFI = 0.99; IFI = 0.99; TLI=0.98; RMSEA = 0.026). Nevertheless, age and social desirability bias did not have significant effects and were thus removed for the purpose of parsimony. The model was reestimated and presented good fit ($\chi^2(168) = 243.2$; $\chi^2/DF=1.45$, CFI = 0.99; IFI = 0.99; TLI=0.98; RMSEA = 0.035). We present the path coefficients for men and women and explained variances in Figure 1.

The results largely support our assertions. Consistent with our hypothesized asymmetric gender-role effects, whereas women's IT major and career choices were guided by their implicit gender identity, men's IT major and career choices were not influenced by their implicit gender identity. Explicit gender identity had no impact on men's and women's IT major and career choices. There are also apparent differences in the role of IT work experience, which is important for men's university major and career intentions, but not for women's.

**Table 3: Reliabilities and Construct Correlations**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| (1) Implicit gender identity | **0.72 (0.80) [0.78]** | | | | | | | | |
| (2) Explicit gender identity | -0.02 | **0.91 (0.90) [0.94]** | | | | | | | |
| (3) Social norms regarding IT career | -0.08 | -0.05 | **0.83 (0.89) [0.88]** | | | | | | |
| (4) Intentions to major in IT | -0.16* | -0.13 | 0.61** | **0.92 (0.97) [0.95]** | | | | | |
| (5) Intentions to pursue IT career | -0.16* | -0.10 | 0.63** | 0.80** | **0.91 (0.97) [0.94]** | | | | |
| (6) Age | 0.08 | -0.01 | 0.12 | 0.12 | 0.14 | | | | |
| (7) Gender | -0.02 | 0.09 | -0.22** | -0.17* | -0.19** | 0.03 | | | |
| (8) IT work experience | 0.10 | 0.04 | 0.12 | 0.12 | 0.20** | 0.63** | 0.05 | | |
| (9) IT skills | -0.08 | -0.03 | 0.34** | 0.30** | 0.35** | 0.06 | 0.00 | 0.11 | |
| (10) Social desirability bias | 0.04 | -0.06 | -0.05 | -0.16* | -0.16* | -0.07 | 0.15* | 0.01 | -0.18* |

*Notes:* * $p < 0.05$, ** $p < 0.01$. On the diagonal: square root of average variance extracted, (Cronbach's alpha), and composite reliability.




*Notes:* Dashed boxes indicate control variables. Dashed arrows indicate control variable effects. For control variable effects and R-squared values, top values indicate coefficients for men; bottom values indicate coefficients for women.

**Figure 1. The Structural Models**

**Table 4. Path Comparisons**

| | Men | | Women | | Difference |
|---|---|---|---|---|---|
| | **Estimate** | **p** | **Estimate** | **p** | **z-stat** |
| **Explicit gender identity → Intentions – IT major** | -0.15 | 0.078 | -0.08 | 0.346 | -0.200 |
| **Explicit gender identity → Intentions – IT career** | -0.13 | 0.135 | -0.11 | 0.188 | 0.651 |
| **Implicit gender identity → Intentions – IT major** | 0.00 | 0.938 | **-0.27** | **0.019** | **2.348**** |
| **Implicit gender identity → Intentions – IT career** | -0.01 | 0.937 | **-0.30** | **0.009** | **2.588**** |
| **Social norms regarding IT career → Intentions – IT major** | **0.45** | **0.000** | **0.52** | **0.000** | 1.133 |
| **Social norms regarding IT career → Intentions – IT career** | **0.58** | **0.000** | **0.59** | **0.000** | -0.571 |
| **IT work experience → Intentions – IT major** | **0.20** | **0.011** | 0.01 | 0.955 | **2.024**** |
| **IT work experience → Intention – IT career** | **0.24** | **0.002** | 0.12 | 0.193 | **1.749*** |
| **IT skills → Intention – IT major** | 0.06 | 0.505 | **0.18** | **0.032** | -0.901 |
| **IT skills → Intention – IT career** | **0.28** | **0.002** | 0.06 | 0.480 | **1.963**** |

*Note:* The estimates are nonstandardized

## 4.2 Post Hoc Gender Differences Analysis

While the proposed model implies that men and women differ in the extent to which they integrate explicit and implicit gender identities into IT major and career choice decisions, it does not hypothesize the magnitude and significance of these gender differences. In order to shed light on these differences, we generated parameter pairwise comparisons in AMOS 25 and path-by-path differences were compared between men and women. The results (unstandardized coefficients, the *z*-score for the differences, and their *p*-values) are presented in Table 4. Our results indicate that implicit gender identity plays a substantially different role for men versus women. Whereas it appears to have no effect on IT career and academic path choices for men (which are presumably perceived as largely masculine), it does have an effect for women. Our results also indicate that men's choices are influenced more strongly by IT work experience.

# 5 Discussion

## 5.1 Summary

The purpose of this study is to understand the role of explicit and implicit gender identities in the context of women's educational and occupational choices in the field of IT. We used the individual differences theory of gender and IT as a lens of analysis, and we collected data from 185 students at a US university who had not yet declared their majors. The findings reveal several interesting phenomena worth elaborating.

First, this study confirmed the validity of the individual differences theory of gender and IT by showing the importance of within-gender differences among women students in terms of their IT education and career decisions. To understand the shortage of women in the IT profession, researchers should focus more substantially on the differences among women rather than simply exploring differences between men and women. Second, the present investigation extends the individual differences theory of gender and IT in the context of IT major and career choices of women students. Previous research has emphasized the importance of implicit cognition in women's occupational choices, and this study offers strong empirical evidence supporting the existence of subconscious processes that may deter women from joining the IT workforce and choosing IT-related career paths. Third, this study demonstrates potential asymmetries in the way that men and women university students integrate implicit gender identity into their IT career decisions. This suggests that men and women university students may represent two distinct groups with intragroup variations, and, therefore, the differences between the genders alone cannot explain women's underrepresentation in the IT profession. Instead, researchers should focus on women's intragender differences, in terms of subconscious identity.

Fourth, the findings suggest that explicit and implicit gender identities of men university students are not significantly integrated into their decision-making processes and hence do not influence their IT career path choices. Thus, H3a-b and H4a-b are supported (see Table 5). This implies that men university students are aware that their gender is mostly consistent with "masculine" prejudices about the IT profession, and, as a result, they do not need to consider their (explicit and implicit) gender identity in occupational decision-making processes, thereby minimizing their cognitive load and conserving mental resources. Therefore, men university students' occupational choices may be driven by factors that are different from those of women, which further supports the individual differences theory of gender and IT.

Fifth, the results of this study demonstrate that implicit gender identity is an important yet frequently overlooked factor for women university students in IT research. Implicit gender identity subconsciously reduced women university students' intentions to major in IT and pursue an IT career. Hence, H2a and H2b are supported. Sixth, the findings showed that social norms regarding IT career relatively equally impacted men's and women's intentions to major in IT and pursue IT careers. This lends support to H5 and H6 and is consistent with previous studies that also empirically confirmed the importance of subjective norms in IT occupational choices (e.g., see Joshi & Kuhn, 2011). The findings regarding control variables are also informative. They show that IT work experience increases men's university IT major and career choices and that IT skills increase IT career choice for men and IT major selection for women.

Ultimately, the study provides an innovative and somewhat unique model of IT major and career choices that accounts for both conscious and subconscious drivers of such decisions. The findings specifically point to several factors that explain a large proportion of the variation in women's intentions to major in IT (46%) and pursue a career in IT (55%). As such, our findings have interesting theoretical and practical implications and pave the way for further research on the conscious and subconscious processes that impact the inclusion of women in the IT workforce.

**Table 5: Hypotheses Summary**

| Hypothesis | Men | Women |
|---|---|---|
| Explicit gender identity → IT major BI | H3a: No effect | H1a: No effect |
| Explicit gender identity → IT career BI | H3b: No effect | H1b: No effect |
| Implicit gender identity → IT major BI | H4a: No effect | H2a: Effect |
| Implicit gender identity → IT career BI | H4b: No effect | H2b: Effect |
| Social norms → IT major BI | H6a: Effect | H5a: Effect |
| Social norms → IT career BI | H6b: Effect | H5b: Effect |

## 5.2 Theoretical Implications

First, the findings of this study indicate that men's and women's IT major and career intentions are influenced by normative pressures. This is consistent with behavioral theories (Ajzen, 1991); people gravitate toward complying with social norms because not doing so can have adverse personal and social consequences (Osatuyi & Turel, 2019). While there were some minor differences in the strength of the impact of social norms on IT major and IT career intentions between men and women, these differences were not statistically significant. As such, we concluded that both genders were equally susceptible to integrating social norm pressures into their career path choices. This finding is also consistent with the individual differences theory of gender and IT and suggests that personal influences (mentors, role models, teachers, peers) represent an important determinant of women's IT education and career intentions. At the same time, it shows that this factor also applies to men because their behavior is similarly driven by social norms.

This observation may be explained theoretically. In general, women are more easily influenced by social pressures than men, but this discrepancy mostly results from the inequalities between the gender's formal status and job roles (Eagly, 1983). However, both genders conform similarly to group and peer pressure when such inequalities are absent (Eagly & Chrvala, 1986). In the current context, since no status and role inequalities were present between men and women university students, both genders responded likewise to the influence of those whose opinion they value. Future research in the area of IT career choices may consider accounting for social norms while controlling for the impact of perceived inequalities between men's and women's formal status and gender roles, as these are not only important predictors of IT career path choices, but are also instrumental for both genders; as such, they can extend research focusing on both men's and women's IT career path choices.

Second, in this study, it was observed that gender identity plays different roles between men and women in its influence on IT major and career intentions. This asymmetry is unique and stems, as per our theorizing, from the fact that specific job roles are primarily associated with one or the other gender (e.g., IT jobs in our case) and present different social profiles for different genders. In our case, we posited that women choosing an IT career path may perceive some incongruence with their commonly developed gender identities and that the expected discomfort associated with this incongruence may deter them from choosing IT majors and careers. Men are theorized as not susceptible to such considerations as their gender is largely consistent with the IT-role identity, which is typically perceived as including masculine elements. The findings supported these assertions and further emphasized the differences between the genders with respect to their implicit gender identities. In this study, it was found that implicit gender identity is a strong predictor of IT major and career intentions for women but not for men. The observation above is also consistent with the individual differences theory of gender and IT, which emphasizes the significance of women's within-gender factors and, particularly, individual differences in gender identity.

Moreover, the present study extends the theory by hypothesizing and empirically demonstrating that women's gender identity is comprised of two conceptually distinct factors: explicit, which functions within the person's conscious awareness and which may be measured through self-reports; and implicit, which exists beyond one's conscious awareness and which may be only measured indirectly. The observed importance of implicit gender identity in this context suggests that future research should consider adding implicit gender identity, and perhaps other subconscious concepts (e.g., subconscious implicit attitudes toward IT), to models of IT career choices. This would allow researchers to generate a fuller picture of people's decision-making, because only a small portion of human decision-making processes is at the conscious level and can be easily self-reported (Joseph, 1992). This is also consistent with dual-system theories in IS research that emphasize the dual, conscious and subconscious, nature of humans (Turel & Qahri-Saremi, 2018; 2016). The asymmetry we observed here suggests that future research should consider theorizing and testing separate models for men and women in the case of gender identity and should further integrate explicit and implicit gender identities in terms of IT career choice decisions.

Third, in this study, we discovered that IT skills contributed to women's intentions to major in IT. The individual differences theory of gender and IT includes a number of personal characteristics, including IT skills (Trauth et al., 2016). The present study confirms the validity of the theory and shows that having previous IT skills positively influences women's intentions to select an IT major. This is consistent with the theory because IT skills are based on women's formal and/or informal education and can be associated with elevated levels of IT abilities and self-efficacy. Finally, as indicated in Table 4, we found various differences in the structural relationships of the models when these were tested for men and women separately. These findings illuminate the need to theorize and independently analyze effects of IT work and skills in men and women samples, as these factors, too, present asymmetric effects between the genders.

Ultimately, this study introduced the concept of implicit gender identity to IS research and specifically to research on gender imbalance in the IT profession. It demonstrated that implicit gender identity may be a culprit that drives

women away from the IT profession and that implicit gender identity is not an influential factor for men.

## 5.3 Practical Implications

Our findings indicate that three factors may influence women's representation in the IT workforce by increasing their likelihood of majoring in IT during their university studies and developing career aspirations for IT-related jobs. These factors are implicit gender identity, social norms regarding IT careers, and IT skills. It seems logical to suggest that changing implicit feminine gender identity could be a means to increase the likelihood of choosing an IT career path. However, since changing implicit gender identity is unethical and unreasonable, stakeholders such as human resource managers and educators should pursue other avenues, with the understanding that women are disadvantaged in that their implicit gender identities are incongruent with the mostly masculine role expectations associated with the IT profession. As a society, though, we can and should change the masculine connotation of the IT profession.

Another way to reduce this disadvantage is to focus on the modification of the mechanism that governs the integration of implicit gender identity into decision-making in order to weaken the relationship between implicit gender identity and IT occupational choices. The key issue is that implicit gender identity and its occupational choice impacts exist beyond women's conscious awareness. Research shows that when individuals are motivated to deliberate on their behavior and are given an opportunity to do so, they can consciously override, at least to some extent, the behavioral impact of their implicit cognitive processes (Fazio, 1990; Olson & Fazio, 2009). Therefore, the first step may be to make women aware of the existence of their implicit gender identity. This could be done by explaining the notion of implicit gender identity and its decision-making consequences in order to motivate women to engage in deliberate cognitive processing. This should be done in a low-pressure environment that gives women ample time to reflect upon their prospective occupational choices. If women were motivated to reflect on the factors driving their behavior, they could make occupational choices based on facts rather than prejudice-driven automaticity. In addition, becoming aware of the subconscious mechanism driving their career decisions could help women carefully reconsider their career options and thereby somewhat reduce its impact.

If women could increase the congruence between their gender identities and professional IT roles (as in the case of men), then they would not integrate these identities into their career choice decisions (as demonstrated here with men). While we did not test ways of doing this, it is reasonable to assume that it could be done by creating stronger associations between women and the IT profession, such that these are not perceived as incongruent categories. The key goal should be to reduce or eliminate prejudice about masculine orientations of the IT profession. Given that prejudice is often developed in childhood and adolescence, interventions, such as using more IT women-leaders as role models, recruiting more women IT teachers, using textbook examples with women IT workers, introducing formal women-led internship programs, avoiding masculine labels, and presenting examples of successful women's careers in IT should be explored. Formal and informal antiprejudice training initiatives may also help women reduce their perception of IT as a masculine field. Offering flexible work hours, part-time work schedules, and telecommuting may also create a perception that the IT profession is accessible to women who have various domestic responsibilities. Other measures, such as equal pay and offering parental leave for both men and women employees, may focus on the promotion of equality between men and women IT workers, which may further reduce the masculine prejudice associated with the IT profession.

Our findings also point to the ability of social norms regarding IT careers and IT skills to increase the likelihood of women choosing IT career paths. Both of these factors are malleable. Social norms rely on input from peers, educators, and parents. IT skills can be acquired through formal and informal training and the incorporation of IT skills into primary and secondary school curricula. Hence, future research could explore interventions aimed at increasing IT training for women starting at a young age (e.g., having mandatory rather than elective IT courses). It could also consider interventions aimed at increasing social norms regarding IT careers—for example, informing peers of their power to influence individuals, channeling their influence to endorse IT careers, and leveraging social media to suggest that IT career paths for women are socially acceptable and encouraged.

## 5.4 Limitations and Future Research Directions

Six limitations of this study are noteworthy. First and foremost, this study did not directly take into account the perspective of LGBTQ people. Prior research has suggested that implicit measures of gender identity of LGBTQ individuals are more accurate than their explicit measures (e.g., see Gray & Snowden, 2009; Snowden & Gray, 2013; Snowden et al., 2008; Weinstein et al., 2012; Windsor-Shellard & Haddock, 2014). Nevertheless, because no sexual orientation data were collected, the present study did not investigate this claim. It is also not clear whether the gender identity of LGBTQ people differs from that of cis individuals. For example, lesbian women may not be constrained by the same expectations of femininity

as straight women, and they may find it to be more acceptable to exhibit masculine behavior consistent with prejudices about the masculine nature of the IT profession (Trauth & Booth, 2013; Trauth & Quesenberry, 2006). It is also possible that transgender people may exhibit a unique perspective on gender identity that should be taken into consideration. Because our theory focuses on gender and not on sexual orientation, we focused on gender-based differences. However, gay men and trans men may develop gender identity in different ways than cis men do, which may influence their career decisions in many domains, including IT. For example, it is possible that gender identity has an impact on the IT career choices of gay and trans men but not of cis men. Thus, future researchers are advised to explore this issue in detail. For example, we recommend that future scholars adapt the measures employed in this study to the LGBTQ context and seek LGBTQ respondents. A quantitative study could be followed by a series of interviews to better understand the LGBTQ perspective.

Second, our sample consisted of US students. This limits its generalizability to people of different regions and cultures (Palvia et al., 2017) and to people of different ages (e.g., elementary school children). Future research should therefore consider replicating our findings in different contexts. Third, while our model explains a large proportion of variance in IT career and major intentions and is relatively parsimonious, much of the variance in these choices has yet to be explained. In the context of the IT profession, prior research has emphasized the influence of race and ethnicity on within-gender variation in gender stereotypes held by university students and has shown that implicit gender identity might vary by race and ethnicity (Trauth et al., 2016). Hence, future research should consider additional constructs that map onto the families of factors included in the individual differences theory of gender and IT, particularly race and ethnicity; future research should also extend this theory to include more factors and integrate this theory with other theories involving career choice. Fourth, the individual differences theory of gender and IT presents other important individual factors expected to impact women's IT career decisions. For example, IT identity, defined as "the extent to which an individual views use of an IT as integral to his or her sense of self" (Carter & Grover, 2015, p. 931) may also exist in both explicit and implicit forms. Thus, it would be interesting to apply this study's conceptual framework and methodology to understand its role in the context of women's IT career choices. Fifth, in addition to the IAT, there are other methods for measuring implicit constructs (e.g., physiological measures of brain activity). Future research could supplement the IAT with brain imaging techniques as a means of capturing subconscious processes that underlie IT university major and career choices.

Finally, the definition of masculinity and femininity is not cast in stone—it changes according to national culture, subculture, and over time. For example, one hundred years ago, women in the US had just won the right to vote, whereas now they occupy senior positions in politics and major IT corporations, including Facebook and Google. It is likely that this trend will persist in the future and that the role of gender identity in the context of career decisions will change. This presents both challenges and opportunities for future researchers who choose to continue the line of research presented in this study. It also makes our findings potentially transient; they may change as the perception of "women's work" in the context of IT jobs evolves.

In addition, future scholars may employ elements of explicit and implicit gender identities in their theorizing when creating new or extending existing IS models and theories. Previous IS research focusing on developing and testing causal models has predominantly explored the role of gender as a predictor, moderator, or control variable and has rarely considered gender identity as a continuous variable instead of binary gender. For example, gender is included as a moderator in the unified theory of acceptance and use of technology (UTAUT) and its extensions (Venkatesh et al., 2003; Venkatesh, Thong, & Xu, 2012). However, it would be interesting to explore the moderating effect of explicit and implicit gender identities on the model's relationships because the gender identity of men and women may differ from their binary self-declared gender and/or biological sex, and thus produce different impacts. It has been also established that men's and women's technology usage decisions are influenced by different factors. For instance, men are more strongly impacted by perceptions of usefulness whereas women tend to emphasize ease of use (Venkatesh & Morris, 2000). However, how do users' explicit and implicit gender identities affect their emphasis on technology perceptions? What impact does gender identity have on technology acceptance or continued use decisions? Answering such questions may further improve our understanding of human-computer interaction processes and lead to important practical recommendations. Similarly, recent neuro-IS studies have pointed to differences in IS-related behaviors based on biological sex (Riedl, Hubert, & Kenning, 2010). Whether such differences are gender dependent, whether explicit or implicit, is an open question. As such, virtually any model that includes a gender variable may be extended by introducing explicit and implicit gender identities and tested within various domains.

In fact, given that many of the gender-difference studies are older (Venkatesh & Morris, 2000), the IS community should consider reexamining them in light of the view of explicit or implicit gender identity being independent of one's self-declared gender. Thus, for example, those who, in the past, were classified as women, may have masculine explicit and/or implicit gender identity; and as per our results, such subtle differences can affect their decisions. Thus, future IS research should question previous findings based on self-declared gender, consider going beyond self-declared gender as a binary variable, and examine how explicit and implicit gender identities affect IS user behavior.

Overall, we suggest that future researchers should first extend existing IS models by incorporating explicit and implicit gender identities as predictors or moderators of the model's relationships. Based on the findings, new theories may emerge and existing ones may be extended or modified. Particular attention should be paid to the between- and within-gender differences in terms of their explicit and implicit gender identities. Subsequently, researchers may explore additional concepts—for example, implicit gender stereotypes, implicit self-efficacy, and implicit attitude, in the context of career decisions and beyond. As such, the notion of subconscious processes presented in this study may offer fruitful avenues for future research, and it raises the need to reexamine findings from prior research, which were primarily based on self-declared gender.

# 6 Conclusion

This study extends research on gender inequality in the IT profession by hypothesizing and testing a model that taps into key conscious and subconscious drivers of IT university major and career choices. The findings show that the integration of subconscious incongruent gender-identity and IT profession-role perceptions is salient in women but not in men university students, which may deter women university students from joining the IT workforce. We call for future research to extend these findings and discover ways to increase gender equality in the IT profession.

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# Appendix A

**Table A: Measurement Scales**

| Construct | Scale |
|---|---|
| Implicit gender identity. *Free*IAT software tool by Meade (2009). | Two indicators based on: (1) the first half of the stimuli, and (2) the second half of the stimuli. These indicators are continuous variables (i.e., reflecting the degree of implicit gender identity). |
| Explicit gender identity. Adapted from the most frequently used items by Cundiff et al. (2013), Ebert et al. (2014), and Kiefer & Sekaquaptewa (2007). | Overall, I identify myself as being:<br>– only woman; mostly woman; somewhat woman; equally woman or man; somewhat man; mostly man; only man<br>– only she; mostly she; somewhat she; equally she or he; somewhat he; mostly he; only he<br>– only her; mostly her; somewhat her; equally her or him; somewhat him; mostly him; only him<br>The scale contained 7 points (1-7). Men and women completed different versions of this scale so that 7 (the highest score) corresponded to their gender (i.e., 1 represented identification with the opposite gender and 7 represented identification with one's own gender). |
| Social norms regarding IT career. Adapted from Morris & Venkatesh (2000). | – People who influence my behavior think that I should pursue a career in information systems.<br>– People who are important to me think that I should pursue a career in information systems.<br>– The school and professors have been helpful in driving me to pursue a career in information systems.<br>– In general, the school and professors have supported decisions to pursue a career in information systems.<br>*Note:* the items pertained to information systems, not to information technology to be consistent with the formal title of the major offered by the university where the study was conducted.<br>(1 = *Strongly Disagree*, 7 = *Strongly Agree*) |
| Behavioral intentions to major in IT. Adapted from Venkatesh et al. (2003). | – I intend to select an information systems major during the course of my studies.<br>– I predict I would select an information systems major during the course of my studies.<br>– I plan to select an information systems major during the course of my studies.<br>(1= *Strongly Disagree*, 7 = *Strongly Agree*) |
| Behavioral intentions to pursue IT career. Adapted from Venkatesh et al. (2003). | – I intend to pursue an information systems-related career after graduation.<br>– I predict I would pursue a career in information systems after graduation.<br>– I plan to select a career in information systems after graduation.<br>(1 = *Strongly Disagree*, 7 = *Strongly Agree*) |
| IT work experience. | How many years of work related to information systems do you have? |
| IT skills. Items were adapted from He & Freeman (2010). | I have good knowledge of and skills related to …<br>– Computers in general.<br>– Databases.<br>– Windows or another operating system.<br>– MS Excel.<br>– MS Word.<br>– Programing languages.<br>– MS PowerPoint.<br>– Social networking websites (e.g., Facebook).<br>– Smartphones.<br>(1 = *Strongly Disagree*, 7 = *Strongly Agree*) |

| | |
|---|---|
| Social desirability bias. Source: Reynold (1982). | Please indicate whether the statements below are true or false with respect to yourself (*True/ False*):<br>– It is sometimes hard for me to go on with my work if I am not encouraged.<br>– I sometimes feel resentful when I don't get my way.<br>– On a few occasions, I have given up doing something because I thought too little of my ability.<br>– There have been times when I felt like rebelling against people in authority even though I knew they were right.<br>– No matter who I'm talking to, I'm always a good listener.<br>– There have been occasions when I took advantage of someone.<br>– I'm always willing to admit it when I make a mistake.<br>– I sometimes try to get even, rather than forgive and forget.<br>– I am always courteous, even to people who are disagreeable.<br>– I have never been irked when people expressed ideas very different from my own.<br>– There have been times when I was quite jealous of the good fortune of others.<br>– I am sometimes irritated by people who ask favors of me.<br>– I have never deliberately said something that hurt someone's feelings. |
| Gender | Man, woman, other (please specify). |

# Appendix B

**Table: IAT Design**

| Block | # of trials | Left key | Right key |
|---|---|---|---|
| Version 1 | | | |
| 1 (practice) | 20 | Construct: Me (I, self, my, mine, myself) | Construct: Others (they, them, their, other, theirs) |
| 2 (practice) | 20 | Attribute: Female (she, her, woman, mother, sister) | Attribute: Male (he, him, man, father, brother) |
| 3 (test) | 40 | Me + Female | Others + Male |
| 4 (practice) | 20 | Construct: Others (they, them, their, other, theirs) | Construct: Me (I, self, my, mine, myself) |
| 5 (test) | 40 | Others + Female | Me + Male |
| Version 2 | | | |
| 1 (practice) | 20 | Construct: Others (they, them, their, other, theirs) | Construct: Me (I, self, my, mine, myself) |
| 2 (practice) | 20 | Attribute: Male (he, him, man, father, brother) | Attribute: Female (she, her, woman, mother, sister) |
| 3 (test) | 40 | Others + Male | Me + Female |
| 4 (practice) | 20 | Construct: Me (I, self, my, mine, myself) | Construct: Others (they, them, their, other, theirs) |
| 5 (test) | 40 | Me + Male | Others + Female |
| Version 3 | | | |
| 1 (practice) | 20 | Construct: Others (they, them, their, other, theirs) | Construct: Me (I, self, my, mine, myself) |
| 2 (practice) | 20 | Attribute: Female (she, her, woman, mother, sister) | Attribute: Male (he, him, man, father, brother) |
| 3 (test) | 40 | Others + Female | Me + Male |
| 4 (practice) | 20 | Construct: Me (I, self, my, mine, myself) | Construct: Others (they, them, their, other, theirs) |
| 5 (test) | 40 | Me + Female | Others + Male |
| Version 4 | | | |
| 1 (practice) | 20 | Construct: Others (they, them, their, other, theirs) | Construct: Others (they, them, their, other, theirs) |
| 2 (practice) | 20 | Attribute: Male (he, him, man, father, brother) | Attribute: Female (she, her, woman, mother, sister) |
| 3 (test) | 40 | Others + Male | Others + Female |
| 4 (practice) | 20 | Construct: Me (I, self, my, mine, myself) | Construct: Me (I, self, my, mine, myself) |
| 5 (test) | 40 | Me + Male | Me + Female |

*Note*: Depending on the IAT version and the subject's gender (which was reported in the survey), the IAT scores were converted so that the resulting score was consistent with the subject's self-reported gender and, therefore, reflected his or her implicit gender identity (the higher one's score, the higher one's implicit gender identity).

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