Individual Reactions to New Technologies in the Workplace: The Role of Gender as a Psychological Construct

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Using the theory of planned behavior (TPB), individual reactions to a new technology and technology usage behavior were studied over a 12-month period among 552 employees being introduced to a new computer-based system in the workplace. When considering gender as a psychological construct by employing Bem's Sex Role Inventory (BSRI), important distinctions were revealed. Specifically, masculine gender-typed individuals exhibited the same pattern as did men in previous research; feminine gender-typed individuals were different from women in that they were influenced only by subjective norm and PBC. The balanced decision-making process was observed only in the case of individuals categorized as androgynous. The high percentage of women who tested to be androgynous explains the divergence in results from the previous work, and provides evidence of changing gender roles for women in today's organizations and society.

Information technologies are powerful tools for creating a stronger, more competitive organization. However, in order to realize the benefits from any given technology, it must be accepted, adopted, and used by employees of the organization. Landauer (1995) reported that over half the systems deployed in the United States today are underutilized or not used at all. For example, the Internal Revenue Service (IRS) spent about $4 billion on a new system that users rejected. The IRS subsequently steered away from the system.

Clearly, a sound scientific understanding of individual acceptance, adoption, and usage of new technologies is vital to researchers and practitioners. The scientific investigations of this problem have employed several theoretical

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perspectives—two of the widely used models are the theory of planned behavior (TPB; Ajzen, 1985, 1991; Mathieson, 1991) and the technology acceptance model (TAM; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989).

Although user acceptance has been studied extensively over the past decade, gender differences in individual technology acceptance and usage decisions has received little attention (cf. Gefen & Straub, 1997; Venkatesh & Morris, 2000; Venkatesh, Morris, & Ackerman, 2000). In the present work, we seek to extend our understanding of the role of gender in technology acceptance and usage decisions by studying gender as a psychological construct. The importance of this line of inquiry is underscored by the increasing presence of women in the workforce, and the potential to tailor training and managerial interventions more appropriately to both women and men.

Theoretical Development

Gender Differences in Technology Acceptance, Adoption, and Usage Decisions[2]

Within technology acceptance, gender has been studied in three key articles (Gefen & Straub, 1997; Venkatesh & Morris, 2000; Venkatesh et al., 2000). While there are certainly other studies that have investigated gender and technology, we focus on the key recent articles that relate to technology adoption and usage. Each of those studies presented some important steps toward understanding the role of gender, but had some key limitations.

Gefen and Straub (1997) and Venkatesh and Morris (2000) examined the role of gender in the popular TAM in the information system (IS) field. While Gefen and Straub's (1997) paper is particularly important, as it represents one of the first investigations of the role of gender in technology acceptance decisions, their work (a) focused only on the main effects and not on the potential moderating role of gender on key relationships, (b) studied a technology with which users were already familiar, and (c) modeled relationships based on data collected at only one point in time. Venkatesh and Morris (2000) examined the role of gender in TAM, and Venkatesh et al. (2000) examined the role of gender using the TPB via longitudinal studies in new technology introduction contexts. However, all

[2]In understanding an individual's technology-related decisions, it is important to recognize the conceptual distinctions across acceptance, adoption, and usage decisions (Venkatesh et al., 2000). *Acceptance* refers to the initial decision made by the individual to interact with the technology. Since an acceptance decision comes at a time when an individual has limited, if any, experience with the technology, it is a key barrier to technology success. *Adoption* comes after some direct experience with the technology, and after an individual has decided to *accept* the technology. *Usage decisions* refer to judgments about continuing to use the system subsequent to significant direct experience with the technology and wherein an individual has acquired significant knowledge of the technology.

three works share the limitation of treating gender as a biological, dichotomous construct.

Between these two competing theories, we chose to extend the inquiry based on TPB because it is perhaps the more general and, therefore, robust model of behavior, given its application to a wide range of behaviors (for a review, see Ajzen, 1991), including technology acceptance, adoption, and usage (Harrison, Mykytyn, & Riemenschneider, 1997; Mathieson, 1991; Taylor & Todd, 1995). Venkatesh et al. (2000) conducted a 5-month long study among 355 employees being introduced to a new organizationwide information retrieval system (Figure 1 summarizes their findings). Although gender did not moderate relationships between intention and use and short-term use, and between short-term use and sustained use, the strength of this pattern of results comes from the critical role played by gender in influencing key early relationships that directly and indirectly have a lasting influence on usage behavior.

Gender as a Psychological Construct

A vast body of research has found gender differences in a variety of decision-making processes, such as college course and major selection (Gianakos & Subich, 1988; Wilson, Stocking, & Goldstein, 1994); retirement decisions (Talaga & Beehr, 1995); financial decision making (Powell & Ansic, 1997); hospital problem solving (Steffen & Nystrom, 1988); and technology acceptance, adoption, and usage decisions (Venkatesh et al., 2000). In much of this research, including that of Venkatesh et al., gender was conceptualized as biological gender—a trait based on physiological differences. Gender-differences research conducted within that paradigm views individual cognitions and behaviors to be tied to being either female or male. However, with the convergence of gender roles and socialization patterns among women and men in today's society (e.g., increasing presence of women in the workforce, men staying home as care providers for their children), a biological conceptualization of gender is potentially restrictive.

A newer conceptualization of gender is as a psychological construct (Bem, 1981). A review of the literature in this area yields historical conceptualizations of masculinity, femininity, and androgyny (Hunter, 1976), and thus, psychological and sociological dimensions of gender (Maccoby & Jacklin, 1974). Despite disparate theoretical and empirical approaches, the unifying theme throughout this literature is that as children develop, they learn behaviors and traits that can be identified with being female or male. This developed set of associations is comprehensive in that it includes not only those attributes linked to anatomy and biological differences, but also more remote features only tangentially related to gender; for example, the perception of abstract shapes (Bem, 1981).

Given this perspective, emergent research has begun to examine a more sociocognitive basis for gender. For example, Tashakkori (1993) found evidence

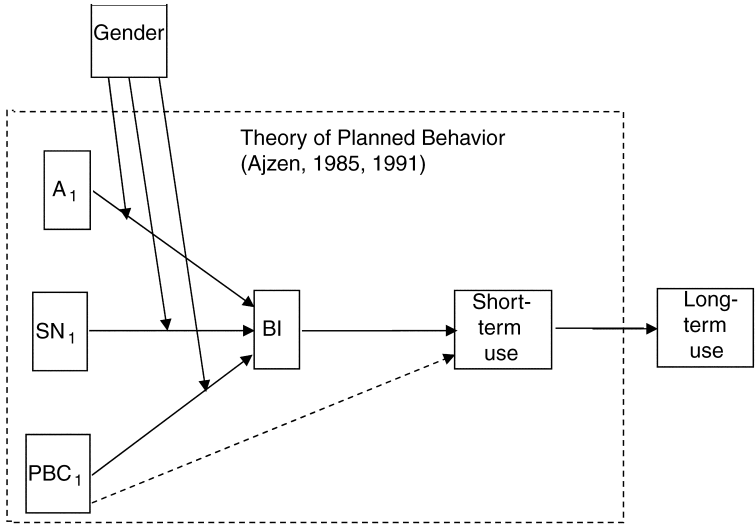

Figure 1. Summary of findings from Venkatesh et al. (2000).
1. Attitude toward behavior (A) is ". . . the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (p. 188). An individual's attitude toward a behavior is determined by beliefs about the consequences of the behavior, and the individual's evaluation of the consequences. Subjective norm (SN) "refers to the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). In the context of technology usage, the key factors underlying subjective norm are peer influence and superior's influence (Mathieson, 1991; Taylor & Todd, 1995). Perceived behavioral control (PBC) is ". . . people's perception of the ease or difficulty of performing the behavior of interest" (p. 183).
2. A, SN, PBC, BI: Measures taken immediately after training.
3. The PBC-Use link was nonsignificant in Venkatesh et al. (2000), although some other studies have found it to be significant (e.g., Taylor & Todd, 1995).
4. The BI to short-term use and short-term use to long-term use relationships were not moderated by gender.

to suggest that the attributes important in determining self-esteem for women and men are different. Gender schema theory (Bem, 1974) has been employed as a powerful paradigm for examining such a sociocognitive basis for gender. Gender schema theory holds that gender-based cognitive structures organize and guide individual perception. How such structures are invoked is based on cognitive availability (Nisbett & Ross, 1980; Tversky & Kahneman, 1973) and suggests that individuals are able to encode, process, and organize schema-consistent information more readily, and thus make highly differentiated (i.e., here, based on gender) judgments consistent with their schemas. Gender schemas are,

therefore, typically viewed as a prescriptive standard or guide (Kagan, 1964; Kohlberg, 1966), causing an unconscious direction of activity consistent with the schema.

Many studies have affirmed the readiness of individuals to process information consistent with their gender-based schemas. For example, both Bem (1981) and Markus and colleagues (Markus, Crane, Bernstein, & Saladi, 1982) found evidence that females and males are able to encode and process gender-consistent information more easily than gender-inconsistent information (i.e., males could recall "masculine" items more readily than "feminine" items), suggesting a more sociocognitive basis for the development and identification of an individual's gender role. Therefore, as a result of the move away from a biological conceptualization of gender, researchers have sought to establish more cognitive-based measures of masculinity and femininity.

From this line of research, Bem's Sex Role Inventory (BSRI; Bem, 1974) has emerged as a widely used and accepted scale[3] designed to provide a cognitive account of gender. The BSRI identifies 60 characteristics that are divided into masculine, feminine, and neutral categories, with 20 characteristics in each category. The 20 masculine attributes are those that are stereotypically associated with men, the 20 feminine attributes are those that are stereotypically associated with women, and the 20 neutral attributes (which are not used in categorization) serve as a filler for measurement purposes. The 60 characteristics included on the BSRI are listed in Appendix A.

Separating the masculine and feminine attributes into orthogonal sets of attributes on the BSRI (Bem, 1974) yields four distinct categorizations: masculine, feminine, androgynous, and undifferentiated. An individual is categorized as being masculine gender-typed (hereafter referred to as *masculine*) if she or he tests high on masculine characteristics (e.g., aggressive, forceful, independent) and low on feminine characteristics. An individual is categorized as being feminine gender-typed (hereafter referred to as *feminine*) if she or he tests high on feminine characteristics (e.g., affectionate, gentle, tender) and low on masculine characteristics. Thus, it is worth highlighting the point that a categorization of masculine not only means the endorsement of male attributes, but also a simultaneous rejection of female attributes. Similarly, a categorization of feminine implies an endorsement of female attributes and a rejection of male attributes (Bem, 1974). An individual is categorized as being *androgynous* if she or he scores high on both male and female characteristics. An individual is categorized as being *undifferentiated* if she or he scores low on both male and female characteristics. While a continuous variable will allow us to retain more variance, in

[3]The BSRI, while widely used and accepted, is not without its detractors (see Pedhazur & Tetenbaum, 1979, for a critique). Nonetheless, the BSRI remains the most widely accepted and used scale within the domain of gender differences.

order to emphasize the practical significance of the distinction, we elected to code these as categorical variables.

Hypothesis Development

The current work seeks to combine the best attributes of previous work to arrive at a more complete understanding of the role of gender in technology acceptance. In order to accomplish this goal, we treated gender as a psychological construct (Bem, 1974, 1981). Specifically, by using the BSRI (Bem, 1974), the current work examines the role of gender on technology acceptance, adoption, and usage decisions within the context of the TPB. Given that Bem's work on gender as a psychological construct has existed for well over a decade, it begs the question: Why did the earlier work not treat gender as a psychological construct to begin with? There are two plausible explanations worthy of note. The first explanation is that since there was little or no prior research on gender differences in technology acceptance and usage decision-making processes, a simple treatment of gender presented an important first step. A second explanation is that studying gender as a psychological construct requires an additional 60 items, and preliminary evidence from a traditional treatment of gender was essential to justify the substantial increase in the length of the survey.

In this section, we discuss the expected decision-making patterns among the various categories of BSRI (Bem, 1974); namely, masculine, feminine, androgynous, and undifferentiated. Figure 1 presents the research model employed in Venkatesh et al. (2000). As noted earlier, their research has conceptualized gender as a dichotomous variable. In this research, we test the same model by conceptualizing gender as a psychological construct. Table 1 presents a summary of Venkatesh et al.'s findings and this paper's hypotheses.

Masculine. In suggesting that men would be more influenced by attitude, an attribute that reflects instrumentality in the workplace,[4] Venkatesh et al. (2000) argued that men tend to focus on objective and logical aspects, including instrumentality and goals. In addition, men were not influenced by subjective norm. This was attributed to men's high level of independence (Venkatesh et al., 2000). Also, perceived behavioral control was not salient to men, attributed to the high focus on instrumentality and the lower level of importance attached to the effort necessary to achieve set goals and limited need for socialization with support staff (Venkatesh et al., 2000).

Juxtaposing the discussion in the previous paragraph with the BSRI (Bem, 1974) indicates that the causal mechanisms underlying the decision-making

[4]In workplace settings, the attitude construct has been shown to have instrumental, rather than affective determinants (e.g., Davis et al., 1989; Venkatesh et al., 2000). Further evidence is provided by Davis et al., who found that instrumental factors override affective factors in determining usage intentions and behavior.

Table 1

Predicted Relationships for Biological and Psychological Conceptualizations of Gender

Dependent variable	Independent variable	Gender as biological sex		Gender as a psychological construct per BSRI			
		Men	Women	Masculine	Feminine	Androgynous	Undifferentiated
BI	A	Very strong	Significant	Very strong	Nonsignificant	Significant	N/A
	SN	Nonsignificant	Significant	Nonsignificant	Significant	Significant	N/A
	PBC	Nonsignificant	Significant	Nonsignificant	Significant	Significant	N/A
Short-term use	BI	Significant, but no gender differences		Significant, but no gender differences			N/A
Continued use	Short-term use	Significant, but no gender differences		Significant, but no gender differences			N/A
Sustained use	Continued use	Significant, but no gender differences		Significant, but no gender differences			N/A

Note. BSRI = Bem's Sex Role Inventory (Bem, 1974); BI = behavioral intention to use technology; A = attitude toward using technology; SN = subjective norm; PBC = perceived behavioral control.

process of men is consistent with an endorsement of male attributes and a rejection of female attributes. The higher focus on attitude (driven by instrumentality in the workplace) relates to an endorsement of male attributes (per the BSRI; e.g., analytical, competitive, ambitious) without necessarily rejecting any specific female attributes. The nonsignificance of subjective norm relates to the endorsement of male attributes (e.g., self-reliant, independent, self-sufficient) and a rejection of female attributes (e.g., yielding, sensitive to needs of others, understanding). The nonsignificance of perceived behavioral control relates to the endorsement of male attributes (adaptable, self-reliant, independent) and those attributes playing a role in attitude (analytical, competitive, ambitious) that together imply a greater focus on instrumentality and minimalization of process difficulties, and a rejection of female attributes such as those related to social interaction identified earlier.

This implies a reduced reliance on others and a reduced need for interaction with support staff. Thus, women and men could exhibit a very similar decision-making process if they endorse masculinity and reject femininity, as described by BSRI (Bem, 1974). Hence, we hypothesize the following:

> *Hypothesis 1a*. For individuals identified as masculine, attitude toward using the system will have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 1b*. For individuals identified as masculine, subjective norm will not have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 1c*. For individuals identified as masculine, perceived behavioral control will not have a significant influence on behavioral intention to use the system.

Feminine. We discussed earlier that women were influenced by attitude and the associated instrumentality, others' opinions through subjective norm, and process expectancies via perceived behavioral control. Women, when compared to men, were suggested to be less strongly influenced by attitude, primarily attributable to women's lesser focus on instrumental aspects. Women were expected to find subjective norm to be highly salient because of their greater expressiveness, greater interdependence, greater influenceability, and higher level of social interaction. According to gender schema theory, individuals who are categorized as feminine (per the BSRI; Bem, 1974) endorse female attributes and reject male attributes. Broadly, this suggests that those who test to be feminine will emphasize a different set of attributes than will their masculine counterparts in the decision-making process. This suggests that feminine individuals will

not be influenced by attitude, but rather will be influenced by subjective norm and perceived behavioral control.

Specifically, the nonsignificance of attitude will be based on the rejection of male attributes (e.g., analytical, competitive, ambitious) without necessarily relating to endorsement of any specific female attributes, thus resulting in a de-emphasis on instrumentality. Also, the endorsement of female attributes (e.g., yielding, sensitive to the needs of others, understanding), along with the rejection of male attributes (e.g., self-reliant, independent, self-sufficient), will result in salience of subjective norm.

Finally, the significance of perceived behavioral control relates to the endorsement of female attributes related to social interaction; that is, those social-based factors that imply an increased need for interaction with coworkers and support staff in problem solving with respect to system use. Thus, any individual, woman or man, testing to be feminine per BSRI (Bem, 1974) is expected to make decisions about technology, as described by the following hypotheses:

> *Hypothesis 2a*. For individuals identified as feminine, attitude toward using the system will not have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 2b*. For individuals identified as feminine, subjective norm will have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 2c*. For individuals identified as feminine, perceived behavioral control will have a significant influence on behavioral intention to use the system.

Androgynous. Hypotheses 1 and 2 describe technology-adoption decision-making processes of masculine and feminine individuals, respectively. In contrast to masculine and feminine individuals who specifically endorse a set of attributes and reject a set of attributes, androgynous individuals endorse both stereotypical male and female attributes. It may be noted that we argued in the Masculine section that attitude, which is driven by instrumentality, is salient for those who endorse stereotypical male attributes and is largely unrelated to rejection of female attributes. Thus, androgynous individuals will be influenced by attitude in the decision-making process. The endorsement of stereotypical female attributes will result in the salience of subjective norm and perceived behavioral control, consistent with feminine individuals. Thus, cumulatively, for androgynous individuals, we expect all three TPB determinants to be salient. Interestingly, in Venkatesh et al. (2000), the salience of all three determinants was expected for women. Based on our theory, this would imply that a large

percentage of women in the workplace are, in fact, androgynous, rather than feminine. Thus, we hypothesize the following:

> *Hypothesis 3a*. For individuals identified as androgynous, attitude toward using the system will have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 3b*. For individuals identified as androgynous, subjective norm will have a significant influence on behavioral intention to use the system.
>
> *Hypothesis 3c*. For individuals identified as androgynous, perceived behavioral control will have a significant influence on behavioral intention to use the system.

Undifferentiated. The undifferentiated category was created to represent individuals who reject both feminine and masculine characteristics. While an important theoretical distinction and possibly relevant in everyday contexts, we do not expect this to be a relevant category among individuals in the workplace. The minimalization of this category is because it represents a relatively high degree of indifference to a broad range of attributes that is unlikely to exist among any individual, especially in the workplace, since we expect that they would be motivated either by success, competitive work environment, and so forth (masculine attributes); or by social interaction, the pay to support family, and so forth (feminine attributes). Given that we do not expect this undifferentiated category to be applicable to our context, we developed no specific hypotheses for the same.

Understanding behavior: A longitudinal perspective. Consistent with Venkatesh et al. (2000), we predict that intention will influence short-term use, which in turn will predict long-term use, which in turn will predict subsequent use. With regard to the role of TPB constructs, the longitudinal perspective suggests that after significant direct experience with the new technology, individuals will be influenced only by their prior usage and not by constructs such as attitude, subjective norm, perceived behavioral control, and behavioral intention. It is worth noting that Venkatesh et al. hypothesized gender as a moderator of (a) intention on short-term use, (b) short-term use on long-term use, and (c) long-term use on subsequent use. However, none of these relationships were found to be significant, implying that gender did not play a role in moderating these relationships. Similar to the findings related to biological gender, we do not expect these relationships to be moderated by psychological gender.

> *Hypothesis 4*. In predicting behavior, none of the relationships will be moderated by psychological gender.

Method

Participants

A large multinational organization implementing a new organizationwide information system agreed to participate in this study. As a result of concerns arising from millennium date conversion (i.e., the so-called "Y2K bug"), the organization was in the process of converting from a mainframe-based system for internal information and data management in all functional areas to a client-server-based Novell networking architecture with Windows 98-based personal computers in late 1998 and early 1999. All company systems were migrated to the new system setup in January and February 1999. However, the new system had the ability to interface with the old system as a front-end; thus, employees who wanted to do so could still use the old system front-end until November 1999 (i.e., both the old and new front-end user interfaces were available until that time), thus making the use of the new system voluntary.

The organization consisted of 710 individuals. A total of 552 usable responses (322 men, 58.3%; 230 women, 41.7%) were received to test TPB in the technology introduction context at all points of measurement. None of the users had any prior knowledge about the specific software system being introduced.

Procedure

As part of the system-conversion process within the organization, all participants received training on the new system for 2 days. The training session included both system-specific training and change management advice designed to smooth the transition process within departmental subunits. The trainers and software consultants did not know about the research or its objectives. User reactions to the technology were measured immediately after the training.

Measures of actual system use were gathered using system logs in the intervening periods between collection of user reactions, for a total of four periods of actual usage figures: Use_{12} reflects actual system usage that occurred between points T_1 (post training) and T_2 (3 months post-implementation); Use_{23} reflects usage between points T_2 and T_3 (6 months post-implementation); Use_{34} reflects usage between points T_3 and T_4 (9 months post-implementation); and Use_{45} reflects usage between points T_4 and T_5 (12 months post-implementation). Responses across each period of measurement were tracked using barcodes created from each user's login ID. This approach helped us to test the role of psychological gender using the same procedures as Venkatesh et al. (2000).

Measures

The scales used to measure TPB were consistent with those of previous research (Mathieson, 1991; Taylor & Todd, 1995; Venkatesh et al., 2000). Actual

Table 2

Number of Women and Men in Each BSRI Category

BSRI category	Biological gender	*N*	*N* per BSRI category as % of women/men	% of women/men per BSRI category
Masculine	Men	221	221/322 = 68.6%	221/253 = 87.4%
	Women	32	32/230 = 13.9%	32/253 = 12.7%
Feminine	Men	45	45/322 = 14.0%	45/76 = 59.2%
	Women	31	31/230 = 13.5%	31/76 = 40.8%
Androgynous	Men	54	54/322 = 16.8%	54/208 = 26.0%
	Women	154	154/230 = 67.0%	154/208 = 74.0%
Undifferentiated	Men	2	2/322 = 0.1%	2/15 = 13.3%
	Women	13	13/230 = 5.7%	13/15 = 86.7%

Note. BSRI = Bem's Sex Role Inventory (Bem, 1974). The fourth column represents the number and percentage of masculine men, masculine women, feminine men, feminine women, androgynous men, androgynous women, undifferentiated men, and undifferentiated women. The fifth column represents the breakdown of men and women in each BSRI category.

usage behavior (USE), operationalized as the duration of use, was gathered from system logs, similar to Venkatesh et al. and Venkatesh and Speier (1999). The measurement procedure was such that the system automatically logged out inactive users after 5 min. In addition to biological gender itself, potential confounding variables were measured consistent with those variables identified as potential confounds by Venkatesh et al.: income, education, organization position, and computer self-efficacy.

The BSRI (Bem, 1974, 1981) was used to classify individuals as masculine, feminine, androgynous, or undifferentiated. Appendix lists the items used in this research. Individuals were classified as masculine, feminine, or androgynous based on Student *t* ratios between a person's masculine and feminine self-endorsements on the BSRI, as outlined in Bem (1974). Table 2 indicates the raw number of individuals in each of the four BSRI categories, as well as the breakdown of each category as a percentage of the respondent base as a whole.[5]

[5]Note that all four BSRI (Bem, 1974) categorizations are reported here, including *undifferentiated*. Because of the low number of individuals in this category, no hypotheses or analysis were conducted. It remains an important theoretical distinction; however, this category was not found to be meaningful in the sample since, possibly as expected, it represents a degree of indifference not commonly seen in the workplace.

An examination of the psychometric properties of the TPB scales used in this study was conducted. Cronbach's alpha estimates for all scales were over .80, suggesting high reliability. At all points of measurement, convergent and discriminant validities were examined using principal components analysis with direct oblimin rotation. The factor structure matrix suggested convergent validity within scales (loadings > .70) and discriminant validity across scales (cross-loadings < .20). Given that reliability and validity of the measures of the TPB constructs in technology contexts have been demonstrated quite extensively (e.g., Harrison et al., 1997; Mathieson, 1991; Taylor & Todd, 1995; Venkatesh et al., 2000), the specific details of our preliminary analyses are not reported here, especially given the consistency of our results with prior research.

The BSRI (Bem, 1974) instrument was not validated using these traditional procedures, as it comprises formative indicators that sample a domain of coverage, rather than reflective indicators. Much research in the area of scale development suggests that for such formative measures, it is important to ensure domain coverage, and highly collinear measures are in fact a problem. The validity of such scales can only be established by a subjective assessment of content validity and an examination of its relationship to other constructs (Bollen, 1989; Diamantopoulos & Winklhofer, 2001). In the case of the BSRI, extensive prior use lends support to its validity within the domain of gender-differences research.

Results

The descriptive statistics and correlations are presented in Table 3.

Gender as a Biological Construct

In order to add external validity to the results reported in Venkatesh et al. (2000), the data were first analyzed to examine biological gender differences. User reactions measured after training were used to predict system use. Regression analyses were used to examine the TPB relationships among attitude toward using technology (A), subjective norm (SN), PBC, behavioral intention to use technology (BI), and usage behavior (USE). Specifically, the A–BI, SN–BI, PBC–BI, BI–USE, and PBC–USE relationships were examined by introducing a dummy variable, Gender (0 = female, 1 = male), and testing for moderation of the different relationships by Gender.

As in Venkatesh et al. (2000), income, organization level, education, and computer self-efficacy were controlled statistically. The pattern of results (Table 4) is highly consistent with those of Venkatesh et al. In Table 4, model parameters for women and men are indicated separately in order to understand the practical significance of the moderation. The Significance of Difference column reports the significance of the interaction term including gender (e.g., A × GENDER × BI) when testing data from the entire sample.

Table 3

Descriptive Statistics and Correlations

	M	*SD*	Gender	Masculine	Feminine	A	SN	PBC	BI	Use_{12}	Use_{23}	Use_{34}
Gender	—	—	—									
Masculine	5.20	1.02	.42***	—								
Feminine	4.00	0.82	.40***	-.48***	—							
A	4.62	1.02	.31***	.36***	.18*	—						
SN	4.55	0.87	.30***	.24*	.35***	.22*	—					
PBC	4.80	1.01	.27**	.20*	.35***	.24**	.24***	—				
BI	4.86	1.02	.22**	.24**	.26***	.36***	.35***	.35***	—			
Use_{12}	8.80	2.42	.18*	.22*	.24**	.26***	.25**	.20*	.51***	—		
Use_{23}	14.10	2.40	.30***	.34***	.35***	.17*	.18*	.22*	.40***	.52***	—	
Use_{34}	15.00	2.47	.31***	.35***	.34***	.10	.19*	.23**	.39***	.42***	.54***	—
Use_{45}	14.80	2.52	.30***	.37***	.33***	.17*	.20*	.20*	.37***	.38***	.40***	.52***

Note. A = Attitude toward technology; SN = subjective norm; PBC = perceived behavioral control; BI = behavioral intention to use technology. A, SN, PBC, BI = user reactions measured immediately after training. Use_{12} = actual usage behavior between T_1 and T_2. Use_{23} = actual usage behavior between T_2 and T_3. Use_{34} = actual usage behavior between T_3 and T_4. Use_{45} = actual usage behavior between T_4 and T_5.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4

Replication of Venkatesh et al. (2000)

Independent variable	Overall TPB		Men		Women		
	R^2	β	R^2	β	R^2	β	*p*
A	.36	.42***	.35	.58***	.35	.31***	.000
SN		.19*		.07		.28***	.004
PBC		.17*		.03		.26***	.008

Note. TPB = Theory of Planned Behavior (Ajzen, 1985); A = attitude toward technology; SN = subjective norm; PBC = perceived behavioral control. A, SN, PBC = user reactions measured immediately after training. R^2 = behavioral intention (BI) measured immediately after training. BI fully mediates relationship between independent variables and short-term use. In addition, long-term usage is predicted by short-term usage only (i.e., short-term usage fully mediates the influence of initial user perceptions on long-term usage). Consistent with Venkatesh et al., gender did not moderate the relationship between intention and short-term use; also, gender did not moderate the relationship between short-term use and long-term use. See Table 3 for correlations: BI–Use_{12}, Use_{12}–Use_{23}, Use_{23}–Use_{34}, and Use_{34}–Use_{45}.
*$p < .05$. ***$p < .001$.

Gender as a Psychological Construct

We conducted the tests designed to extend the theoretical model shown in Figure 1 while treating gender as a psychological construct. Consistent with the analytical procedures used in the previous work and in the replication reported earlier, regression analyses were used to examine the TPB relationships (A–BI, SN–BI, PBC-BI, BI–USE) by introducing a dummy variable, Gender, and testing for moderation of the different relationships by Gender. In this case, Gender represented the BSRI (Bem, 1974) categorization. We conducted pairwise comparisons across the categories using one dummy variable to allow a comparison of two of the categories at a time. We also conducted a three-way comparison using two dummy variables to represent feminine, masculine, and androgynous. In examining the role of gender, we again statistically controlled for income, organization level, education, and computer self-efficacy.

The results shown in Table 5 indicate that masculine individuals were influenced by attitude ($p < .001$), while subjective norm and PBC were not significant, providing support for Hypotheses 1a, 1b, and 1c, respectively. As expected, the results for feminine individuals were exactly opposite those of masculine users: Attitude was nonsignificant, while subjective norm and PBC were

Table 5

Results by BSRI/Biological Gender Category

		Masculine		Feminine		Androgynous		
		R^2	β	R^2	β	R^2	β	*p*
Combined (men and women)	A	.36	.59***	.34	.04	.34	.22*	.007[a]
	SN		.04		.33***		.28**	.013[b]
	PBC		.06		.40***		.26**	.042[c]
Men	A	.37	.62***	.34	.09	.33	.20*	.006[a]
	SN		.02		.29***		.28***	.031[b]
	PBC		.04		.44***		.28***	.033[b]
Women	A	.36	.60***	.34	.02	.34	.25**	.009[a]
	SN		.07		.35***		.28**	.041[b]
	PBC		.09		.37***		.25***	.027[c]

Note. BSRI = Bem's Sex Role Inventory (Bem, 1974); A = attitude toward technology; SN = subjective norm; PBC = perceived behavioral control. A, SN, PBC = user reactions measured immediately after training. R^2 = behavioral intention (BI) measured immediately after training. BI fully mediates relationship between independent variables and short-term usage. In addition, long-term usage is predicted by short-term usage only (i.e., short-term usage fully mediates the influence of initial user perceptions on long-term usage). Consistent with Venkatesh et al. (2000), gender did not moderate the relationship between intention and short-term use; also, gender did not moderate the relationship between short-term and long-term use. See Table 3 for correlations: BI–Use_{12}, Use_{12}–Use_{23}, Use_{23}–Use_{34}, and Use_{34}–Use_{45}.

[a]Masculine > Androgynous > Feminine. [b]Feminine and Androgynous > Masculine. [c]Feminine > Androgynous > Masculine.

*$p < .05$. **$p < .01$. ***$p < .001$.

both significant ($p < .001$). This pattern of results supports Hypotheses 2a, 2b, and 2c, respectively. Finally, for androgynous individuals, attitude ($p < .05$), subjective norm ($p < .01$), and PBC ($p < .01$) were significant determinants of behavioral intention, providing support for Hypotheses 3a, 3b, and 3c.

Consistent with Venkatesh et al. (2000), the results of this research show that intention determined short-term usage ($r = .51$, $p < .001$), and subsequent usage was always predicted only by usage in the previous period and not by any of the perceptual constructs (A, SN, PBC, and BI) measured in the immediately preceding period. With regard to the prediction of behavior, psychological gender did not moderate any of the relationships, as expected (Hypothesis 4).

Discussion

The current research reveals an important and interesting pattern of findings that go beyond previous research on gender differences in technology acceptance, adoption, and usage decisions. Specifically, using TPB, previous work found that men were driven solely by attitude fueled by instrumentality, while women were influenced by all TPB constructs, suggesting a more balanced decision-making process (Venkatesh et al., 2000). The present study replicated these findings when considering gender as a biological construct, adding external validity to the original results. Moreover, the present study was conducted over a 12-month period (as opposed to 5 months in Venkatesh et al., 2000). Furthermore, by examining gender as a psychological construct, the current research presents an empirical verification of the underlying cognitions (characteristics) that influence decision making about technology across individuals. Thus, it helps better pinpoint the underlying causal mechanisms for apparent differences in technology acceptance, adoption, and usage across women and men. The significance of gender is underscored by the fact that initial decisions that differ based on gender conceptualized per BSRI (Bem, 1974) have a lasting impact throughout the technology adoption life cycle and do, in fact, influence long-term adoption and usage decisions.

In this study, a large percentage of men tested masculine per BSRI (Bem, 1974), and those individuals exhibited decision-making processes consistent with men per Venkatesh et al. (2000). That is, they were influenced only by attitude. However, one interesting additional finding was that women who tested masculine were also only driven by attitude. Another interesting and divergent finding that is rooted in the more psychologically based understanding of gender is that women who tested consistent with a feminine stereotype exhibited a decision-making process not identified in Venkatesh et al. Specifically, these individuals were influenced only by subjective norm and PBC, not attitude toward using. It is possible (even likely, given the results of this study), that the so-called balanced decision-making pattern in women identified in Venkatesh et al.'s study was a result of a mix of masculine and androgynous women in the sample. It is crucial to note that when only those women who are categorized as feminine are considered, instrumental factors (i.e., attitude) disappear, leaving only subjective norm and PBC as important determinants of intention. Adding credence to this argument is the case of cross-gender-typed men (i.e., men who tested feminine). Cross-typed men exhibited the same decision-making process as feminine women.

It is particularly interesting to note that a majority of women (67%) tested androgynous in this study. These androgynous employees exhibited what Venkatesh et al. (2000) called a *balanced decision-making process* that took into account all three determinants of TPB. Androgynous men, a much smaller

percentage, also exhibited the same balanced decision-making process. In hindsight, given the results for feminine individuals in this study (i.e., attitude not significant), it is possible that a large number of androgynous women in the original study biased the results such that all TPB factors were salient for women. Such a pattern can be seen in the biological gender replication in this study. It is only when one partials out those women testing androgynous that the finer-grained distinctions between feminine and androgynous women appear. Given that androgeneity represents an endorsement of both the stereotypical instrumentality-oriented masculine attributes and the stereotypical social-interaction-oriented feminine attributes, the resultant balanced findings have strong face validity. In sum, this suggests that a psychological conceptualization of gender is a more accurate predictor (than is biological gender) of the driving forces behind technology adoption and usage decisions in the workplace.

This pattern of results has important theoretical and practical implications. The categorization of women and men into BSRI (Bem, 1974) categories in and of itself is important for organizational behavior researchers and practitioners, as it presents an important step in understanding individual behavior in the workplace, particularly with the continuing growth of the number of women in the workplace. Although a majority of men tested masculine, there was a significant percentage of men who tested feminine and androgynous. While additional research is needed to test the underlying reasons for this phenomenon, one explanation might be an increased involvement in home life that possibly allows for a more active work life for the spouse in dual-career families.

In contrast, a majority of women were not categorized as feminine. Interestingly, they did not test masculine either, but rather tested androgynous, thus suggesting the potential for changing gender roles in today's society. At a minimum, it appears that a large percentage of women in the workforce may embrace both traditional social-based feminine roles (e.g., compassionate, sympathetic, understanding), as well as those attributes traditionally seen as masculine (e.g., aggressive, ambitious, competitive, forceful).

From a research perspective, the results here suggest that so-called gender-differences research in applied domains that rely on a simply dichotomous conceptualization of gender should carefully consider the implications of doing so. We recognize the practical problems associated with using a 60-item measure in lieu of the typical dichotomous measure of gender (or, more properly, biological gender) as a single measure. Thus, future research might be directed at developing a significantly shorter scale (e.g., using four masculine and feminine attributes, respectively) using relevant psychometric guidelines (for a discussion, see Nunnally & Bernstein, 1994). Such an approach would have substantial practical utility as well. For example, the use of a shortened BSRI (Bem, 1974) to preemptively assess psychological gender could be used in developing tailored training interventions that emphasize key points likely to be salient to the

intended user population (e.g., emphasizing embedded help/support tools or usability; or conversely, focusing on the use of technology to accomplish key tasks in the organizational unit).

Clearly, consistent with the TPB, all factors are important to some segment of the population. However, gaining a better understanding of the intended audience—especially when the cost of doing so is negligible—gives those charged with implementing new systems the best chance at having users not only accept, but actually enthusiastically embrace, the new technology.

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Appendix

Bem's Sex Role Inventory (BSRI, 1974)

Using a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), describe the extent to which each attribute describes you. In other words, if you strongly agree that you "act as a leader," respond with a 7.

(The respondents were given information about each of the points on the 7-point scale.)

Masculine attributes	*Feminine attributes*	*Neutral attributes*
act as a leader	affectionate	adaptable
aggressive	cheerful	conceited
ambitious	childlike	conscientious
analytical	compassionate	conventional
assertive	does not use harsh	friendly
athletic	language	happy
competitive	eager to soothe hurt	helpful
defends own beliefs	feelings	inefficient
dominant	feminine	jealous
forceful	flatterable	likable
has leadership abilities	gentle	moody
independent	gullible	reliable
individualistic	loves children	secretive
makes decisions easily	loyal	sincere
masculine	sensitive to needs of	solemn
self-reliant	others	tactful
self-sufficient	shy	theatrical
strong personality	soft spoken	truthful
willing to take a stand	sympathetic	unpredicatable
willing to take risks	tender	unsystematic
	understanding	
	warm	
	yielding	

List of Items Used

Gender	Female	
	Male	
Educational level:	Some high school or less	Some college
	Graduated high school	Graduated college
	Vocational/technical school	Post-graduate study

Annual individual income (before taxes):	Less than $20,000	$60,000-$69,999
	$20,000-$29,999	$70,000-$79,999
	$30,000-$39,999	$80,000-$89,999
	$40,000-$49,999	$90,000-$99,999
	$50,000-$59,999	$100,000 or more
Position:	Executive/top management	Administrtive/clerical
	Middle management	Technical
	Supervisory	Other (please specify)
		_____

Intention to Use (7-point Likert scale)

Assuming I had access to the system, I intend to use it.

Given that I had access to the system, I predict that I would use it.

Attitude Toward Using (7-point semantic differential scale)

Using the system is a (bad/good) idea.

Using the system is a (foolish/wise) idea.

I (dislike/like) the idea of using the system.

Using the system is (unpleasant/pleasant).

Subjective Norm (7-point Likert scale)

People who influence my behavior think that I should use the system.

People who are important to me think that I should use the system.

Perceived Behavioral Control (7-point Likert scale)

I have control over using the system.

I have the resources necessary to use the system.

I have the knowledge necessary to use the system.

Given the resources, opportunities, and knowledge it takes to use the system, it would be easy for me to use the system.

The system is not compatible with other systems I use.

Computer Self-Efficacy (10-point Guttman scale)

(*Note*. Additional instructions were provided per Compeau & Higgins, 1995a, 1995b.)

I could complete the job using a software package . . .

. . . if there was no one around to tell me what to do as I go.

. . . if I had never used a package like it before.

. . . if I had only the software manuals for reference.

. . . if I had seen someone else using it before trying it myself.

. . . if I could call someone for help if I got stuck.

. . . if someone else had helped me get started.

. . . if I had a lot of time to complete the job for which the software was provided.

. . . if I had just the built-in help facility for assistance.

. . . if someone showed me how to do it first.

. . . if I had used similar packages before this one to do the same job.