

*Unified Theory of Acceptance: U.S. Vs. China*

## **Unified Theory of Acceptance and Use of Technology: U.S. Vs. China**

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### **ABSTRACT**

*This paper seeks to enrich our understanding of research on technology adoption by examining a potential boundary condition, related to culture, of the fairly recently developed model of technology adoption and use—i.e., unified theory of acceptance and use of technology (UTAUT). Based on the cultural differences between the U.S. and China, we outline the similarities and dissimilarities between the hypotheses specified in the original UTAUT, which was validated in the U.S., and how the relationships will play in the context of employees in China. We conducted an empirical study in a single organization that operated both in the U.S. and China and collected longitudinal data from a total of over 300 employees in one business unit in each of the two countries. Our study confirmed our hypotheses that social influence will be more uniformly important across all employees, without contingencies related to gender, age and voluntariness that were found to be the case in the U.S. As we theorized, other UTAUT hypotheses held both in the U.S. and China. This work contributes by examining culture as a boundary condition and identifies the bounds of generalizability of UTAUT.*

### **KEYWORDS**

**Technology Adoption, UTAUT, Cultural Differences, Social Influence.**

### **INTRODUCTION**

The sustained growth of spending on information technologies in organizations (Gartner 2007) continues to motivate research in technology adoption (e.g., Rai et al. 2002; Venkatesh and Davis 2000; Venkatesh et al. 2007; Venkatesh et al. 2003), a precondition for IS implementation success. Prior research has mainly focused on understanding the psychological and sociological factors that will shape an individual's behavioral intention toward using technology (Venkatesh et al. 2003). Based upon conceptual and empirical similarities across prior technology adoption models, Venkatesh et al. (2003) developed the *Unified Theory of Acceptance and Use of Technology* (UTAUT) that not only underscores the main individual-level factors that affect technology acceptance, but also identifies the contingencies that would amplify or constrain the effects of these factors.

Despite the fact that UTAUT is credited with explaining a large portion of variance in behavioral intention toward using technology, empirical tests of UTAUT have been primarily been conducted in the U.S. Although a few studies of UTAUT have been conducted outside the U.S., there has been no systematic comparison across countries and/or cultural settings. In a recent study of 722 knowledge workers, a modified version of UTAUT examined in Saudi Arabia found out less variance was explained and indicated the importance of capturing cultural differences in understanding technology adoption (Al-Gahtani et al. 2007). This suggests the model may perform differently in different cultural settings such that some factors could become more or less important in one culture than they are in other cultures. Only when researchers test and confirm a theory in settings different from the original one, they may properly claim that the theory is generalizable to the new setting (Lee and Baskerville 2003). This requires researchers to compare what the theory would describe as happening in the new setting and what is actually observed as happening in the new setting (Lee and Baskerville 2003).

Given this backdrop, in the current work, we chose to contextualize UTAUT for China as a country to compare. China, the most populous country in the world, has emerged as a key global economic player with a great deal of information technology (IT) implementations. Research has indicated China has become one of the largest centers for offshore IT work (Friedman 2005) that involves provision of IS services, deployment of IS solutions and implementations of configurable information technologies (Kappos and Rivard 2008). Thus, understanding the role of culture in affecting the factors that influence an individual's behavioral intention toward technology adoption is critical for the success of IS implementations in China. A further objective of this paper is to compare the result of UTAUT test in China with findings in a U.S. context. We will accomplish this goal by conducting a longitudinal field study in a single organization that has a presence in both countries, i.e., U.S. and China, that will allow us to contrast the findings in both cultures while holding the organization constant.

Motivated by research that indicates behavioral models do not necessarily hold across cultures (e.g., Broussel 1992), the cross-cultural examination of UTAUT responds to the growing needs of understanding factors that are critical to the success of IT deployment in an increasingly global business environment. In such an environment, incorporation of culture in IS research has been deemed to be relevant and critical (Kapos and Rivard 2008; Leidner and Kayworth 2006). Fully understanding the role of different cultural values and how they play out in different business contexts will help resolve conflicts resulting from mismatch, misinterpretation, or misunderstanding of different cultural values (Kappos and Rivard 2008). By examining how different cultural values relate to other behavioral factors in affecting technology adoption, we gain better understanding of how to leverage cultural factors in terms of maximizing the level of technology adoption and use while reducing the level of resistance.

## **BACKGROUND**

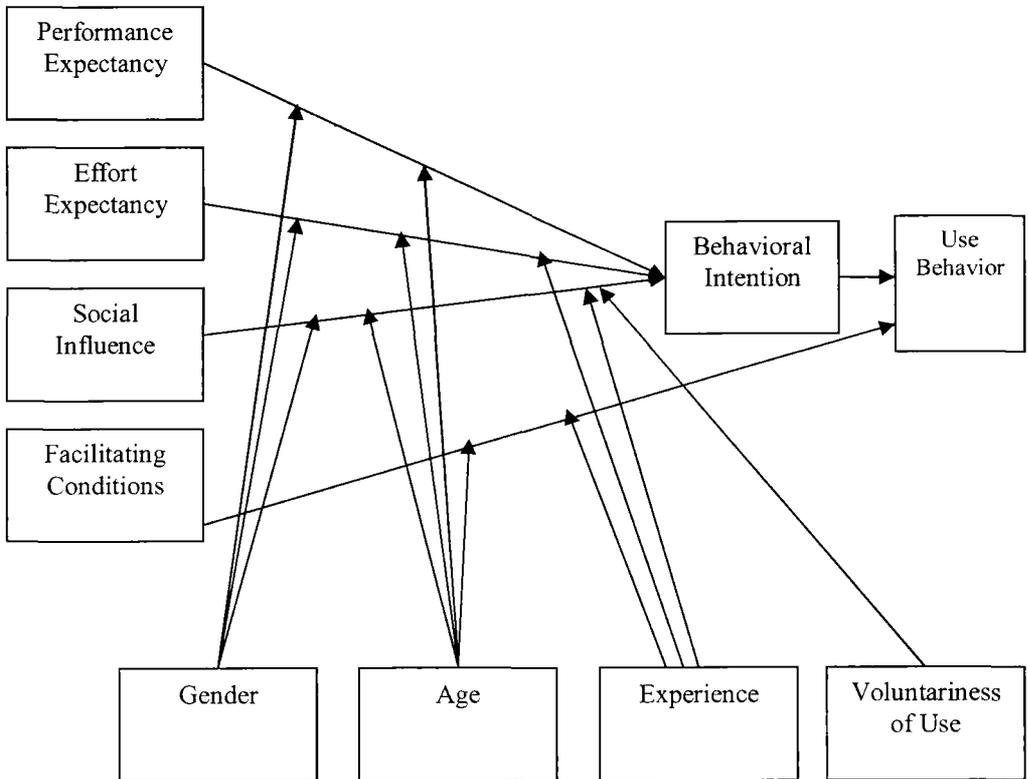
### **UTAUT**

Venkatesh et al. (2003) provides the theory, development and initial empirical tests of UTAUT. Here, we provide a summary of UTAUT's main tenets. By integrating and refining the different models of prior research, UTAUT explained 70% of the variance in technology use. UTAUT identifies 3 direct determinants of behavioral intention to use a technology—i.e., performance expectancy, effort expectancy and social influence—and 2 direct determinants of technology use—i.e., behavioral intention and facilitating conditions—and 4 contingencies—i.e., gender, age, experience and voluntariness—that would alter the effect of the determinants on intention and /or behavior (Figure 1). Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her better attain significant rewards and performance expectancy was found to be a significant determinant of behavioral intention, with its effect varying across gender and age such that the effect is strongest for younger men. Effort expectancy is defined as the degree of ease associated with the use of the system and it was found that the effect of effort expectancy on behavioral intention varies across gender and age such that the effect is strongest for older women in early stages of experience. Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system and it was found that the effect of social influence on behavioral intention was found to be contingent on gender, age, experience, and voluntariness, such that it is the strongest for older women in early stages of experience in mandatory contexts. Facilitating conditions is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system and it was found that the effect of facilitating conditions on technology use was moderated by age and experience such that the effect was strongest for older workers in later stages of experience.

### **Cross-Cultural Research and Technology Adoption**

Schein (1985a, 1985b) defined culture as belief systems that shape individuals' schemas about the world around them. Culture plays a subtle, yet powerful role in influencing people's social behaviors (Leidner and Kayworth 2006). Culture has received considerable research attention in the past two decades (Kappos and Rivard 2008) and has been studied at various levels of analysis including national, organizational, subunit, and individual. To date, the most popular conceptualization of national culture has been Hofstede's taxonomy that includes 5 dimensions: uncertainty avoidance, power distance, long-term orientation, individualism/collectivism and masculinity/femininity, (Hofstede 1980, 1983; Hofstede and Bond 1988). Along the 5 dimensions, China and the U.S. are significantly different along the dimension of individualism/collectivism that reflects

the preference for a social framework where individuals take care of themselves (individualism) as opposed to collectivism where individuals expect group to take care of them in exchange for their loyalty (Hofstede 1980, 1983). On a 100-point scale, the score of China measured along the dimension of individualism/collectivism is 20, i.e., very high on collectivism (very low on individualism) while that of the U.S. is 91, i.e., very low on collectivism (very high on individualism).



Note: All interactions shown are higher-order terms.

**Figure 1. Original UTAUT**

Cultural diversity creates challenges for individuals and organizations. For instance, a large body of research shows the challenges of cultural diversity for multinational work teams (Earley and Gibson 2002; Gurung and Prater 2006), global leaders (Van Dyne and Ang 2006), and those in overseas work assignments (Bhaskar-Shrinivas et al. 2005). Given the importance of this issue, practitioners seek to understand cultural differences so as to tackle the challenges resulting from such differences, while researchers seek to understand the cultural differences so as to advance theory building, such as enhancing the generalizability of the theory in different cultural

settings (e.g., Almutairi 2007). Research in management has examined how national culture plays a role in conflict management (Smith et al. 1998), human resource management (e.g., Ryan et al. 1999), and global leadership (e.g., House et al. 1999). Moreover, research in management has sought to understand how cooperation (e.g., Wagner 1995), work-related attitudes (e.g., Spector et al. 2002), and adapting behaviors (e.g., Molinsky 2007) manifest across different national cultures.

Mirroring research in management, culture has been regarded as a key issue in IS research (Kappos and Rivard 2008; Watson et al. 1997). Leidner and Kayworth (2006) categorizes IS research related to cultures into six groups: (1) culture and IS development; (2) culture, IT adoption, and diffusion; (3) culture, IT use, and outcomes; (4) culture, IT management, and strategy; (5) IT's influence on culture; and (6) IT culture. Prior research has demonstrated how technology adoption may vary across different cultures. In particular, three useful exemplars of study of culture and technology adoption exist—i.e., Gefen and Straub (1997), Srite and Karahanna (2006) and Venkatesh and Ramesh 2006. Gefen and Straub (1997) found women and men differ in their perceptions but not use of e-mail and suggested that researchers should include gender in IT diffusion models along with other cultural effects. Srite and Karahanna (2006) found the effect of social norms on intended behaviors is stronger for individuals high on feminine and uncertainty avoidance cultural values, and the moderating effect of masculinity/femininity was not significant on the relationship between perceived usefulness and behavioral intention but significant on the relationship between perceived ease of use and behavioral intention. Venkatesh and Ramesh (2006) found the conceptualization, metric, and associated instrument based on Microsoft usability guidelines (MUG) could be generalized from the United States to Finland.

## **THEORY DEVELOPMENT**

In seeking to understand the role of culture in the context of UTAUT, we ask the question as to whether the theorized relationships of UTAUT will be the same in China as they were theorized and found to exist in the U.S. by Venkatesh et al. (2003). If they are not identical, what will be the differences and what will the causes of the differences be? We suggest that the relationships about the role of performance expectancy, effort expectancy and facilitating conditions will be the same. The role of social influence will, however, be different in China such that it will be more uniformly important in China. We will develop the theoretical rationale for these hypotheses in the rest of this section.

## **Performance Expectancy, Effort Expectancy and Facilitating Conditions**

UTAUT theorizes the influence of performance expectancy on behavioral intention is the strongest for younger men because they have the strongest desire for material success, such as performance achievement at work. We argue the rationale of explaining the gender and age differences with regard to performance expectancy will not be much different across U.S. and China because younger men in both countries are likely to have the same patterns of emphasis on performance expectancy vis-à-vis women and older individuals in the respective countries. Specifically, men are more interested in performance accomplishments than are women, and younger workers have stronger desire to be successful at their jobs than do older workers. These mechanisms will be no different in both countries. Therefore, we suggest the moderating role of gender and age will be the same in China as it was theorized in the original UTAUT, rooted in theories and empirical evidence from the U.S. Similarly, we argue the moderating role of effort expectancy will be the same in both countries such that the influence of effort expectancy is the strongest for older women in early stages of experience. There is no evidence or reason to believe that the different values held by people in these two countries will result in differences in terms of emphases on effort expectancy. In other words, the process orientation (see Venkatesh et al. 2003) that will be prevalent among women, particularly older women, in early stages of experience can be expected to hold true in China as well. The emphasis on process orientation also governs the role of facilitating conditions, especially among older workers in later stages of experience. Again, we expect the logic to hold in China as well. Therefore, we hypothesize:

*H1a: In China, the effect of performance expectancy on behavioral intention will be moderated by gender and age, such that the effect will be strongest for men and particularly for younger men.*

*H1b: In China, the effect of effort expectancy on behavioral intention will be moderated by gender, age and experience, such that the effect will be strongest for women, particularly younger women, and particularly in the early stages of experience with the system.*

*H1c: In China, the effect of facilitating conditions on behavioral intention will be moderated by age and experience, such that the effect will be strongest for older workers, particularly with increasing experience.*

## **Social Influence**

UTAUT argues the effect of social influence on behavioral intention will be moderated by gender, age, voluntariness and experience, such that the effect will be strongest for women, particularly older women, in the early stages of experience

particularly in mandatory settings. The effect of social influence on individual behavior is mainly through three mechanisms: compliance, internalization, and identification (Venkatesh and Davis 2000; Warshaw 1980). Specifically, the effect of compliance is more pertinent in mandatory settings and the effect of internalization and identification are more pertinent in voluntary settings. In addition, women are more sensitive to others' opinions (Venkatesh et al. 2000). When it comes to the role of age, older workers have a stronger desire for affiliation needs and are thus more likely to be affected by others' views and opinions. Finally, people are generally more responsive to others' opinions when they do not possess much experience with the target behavior—here, using the system (Venkatesh and Davis 2000; Venkatesh and Morris 2000). In such circumstances, an individual will feel uncertain about how to perform the behavior and are more likely to seek advice or help and thus are likely to be influenced by others.

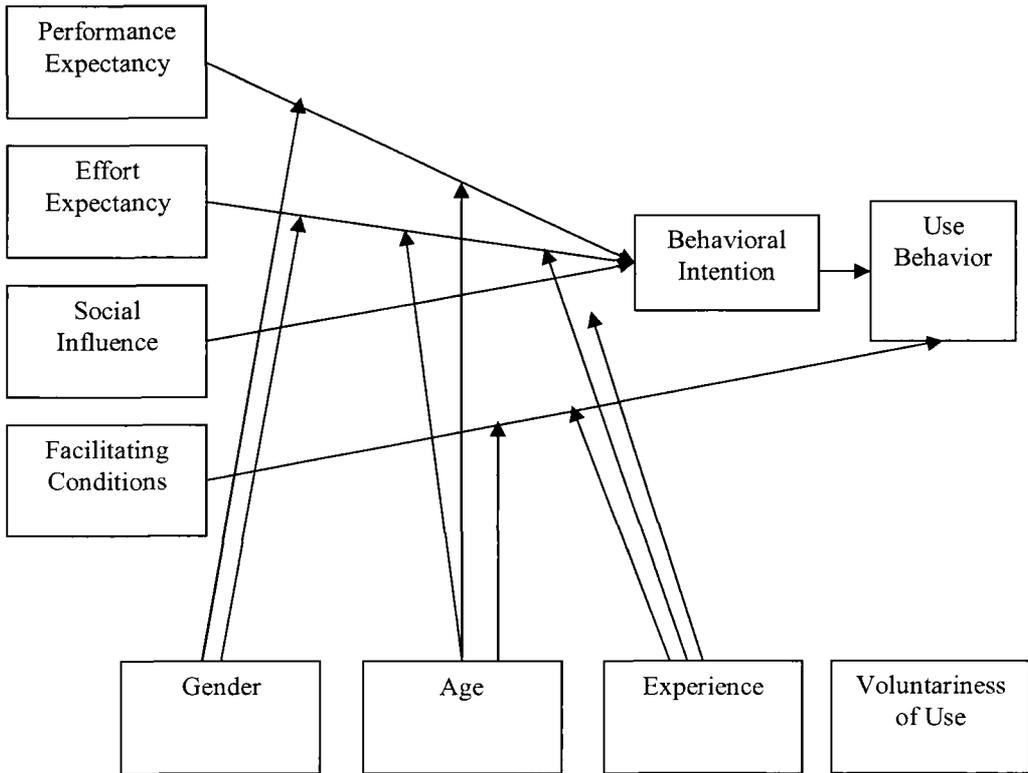
In China, we argue the roles of gender, age and voluntariness will be less salient in affecting the relationship between social influence and behavioral intention. Hofstede (1980, 1983, 2008) indicates China is a more collective culture than the U.S. is. In a collective culture, the goals of the collective have the dominant influence in shaping behavior (Triandis 1989a). In responding to social influence, individuals from such a culture have a strong reference to the collective self (Triandis 1989b) that would make the norms, values, and beliefs of the in-group more salient and individuals are thus more likely to comply with these norms (Bond and Smith 1996; Marcus and Kitayama 1991; Triandis 1989a). Such collective individuals have an interdependent construal of self (Marcus and Kitayama 1991) that would make them become attuned to the perspective of salient others and responsive to the needs of others (Jordan and Surrey 1986). In the strongly collective culture that China is, people have the tendency of working as a collective and respect each others' ideas and opinions, regardless of their gender, age or volitional context. Prior research has shown that collectivists' behavior is more closely linked to norms (Bontempo and Rivero 1990) and collectivistic cultures tend to show higher levels of conformity than individualistic cultures do (Bond and Smith 1996). Individuals high on collectivism are more likely to comply with the opinions of salient others (Srite and Karahanna 2006). Consequently, the effect of social influence on behavioral intention is less likely to vary across gender and age. While the effect of social influence is more salient in mandatory settings in U.S., we do not expect this to play a role in China either. The reason for the non-significant role associated with voluntariness in China is that because it is a collective culture as noted earlier, people have a tendency to seek and work toward consensus, defer to others' opinions or even agree with others, and prefer to avoid conflict that might have a negative impact on relationship building and subsequent collaboration. However, regardless of whether it is the U.S. or China., we argue that the moderating effect of experience will still hold because people in general are more likely to be influenced by others when they are uncertain about their work than they are when they become experienced with a particular target behavior—here, using a system. Therefore, we hypothesize:

*H2: In China, the effect of social influence on behavioral intention will be moderated by experience, such that the effect will be stronger in the early stages of experience.*

Table 1 compares the hypotheses developed in the original UTAUT and the ones developed for China. Figure 2 presents the revised UTAUT that is applicable in China.

**Table 1. Hypotheses Comparison between Original UTAUT and UTAUT for China**

<b>Predictors</b>	<b>U.S.</b>	<b>China</b>
Performance expectancy	The effect of performance expectancy on behavioral intention will be moderated by gender and age, such that the effect will be strongest for men and particularly for younger men.	Same
Effort expectancy	The effect of effort expectancy on behavioral intention will be moderated by gender, age, and experience, such that the effect will be strongest for women, particularly younger women, and particularly at early stage of experience.	Same
Social influence	The effect of social influence on behavioral intention will be moderated by gender, age, voluntariness, and experience, such that the effect will be strongest for women, particularly older women, particularly in mandatory settings in the early stages of experience.	The effect of social influence on behavioral intention will be moderated by experience, such that the effect will be stronger in the early stages of experience.
Facilitating conditions	The effect of facilitating conditions on behavioral intention will be moderated by age and experience, such that the effect will be strongest for older workers, particularly with increasing experience.	Same



Note: All interactions shown are higher-order terms.

**Figure 2. Revised UTAUT**

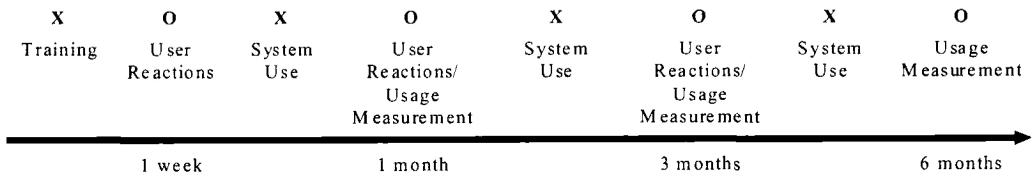
**METHOD**

**Settings and Participants**

We conducted a field study among employees in one business unit in an organization with a presence both in the U.S. and China. The business unit selected performed the same function—i.e., business analysis—in the U.S. and China respectively. Participants in this study were knowledge workers working in the business unit in either China or the U.S. A new technology was being introduced to these employees in both locations. By holding the organization, business unit, and job functions of the participants constant across the two countries, we minimize potential other factors playing a role—thus, the differences observed between China and the U.S. could be attributed to the culture. An English questionnaire containing modified items measuring constructs from UTAUT was administered at three different points in time. Among the employees in the U.S. who participated in the study (N = 149), 100 (67%)

were men, with an average age of 40.22 (S.D = 10.51). Among the employees in China who participated in the study (N = 201), 131 (65%) were men, with an average age of 38.44 (S.D = 10.02). Data were collected at three points in time, consistent with the original UTAUT study. Figure 3 shows the data collection timeline.

**Figure 3. Longitudinal Data Collection Schedule**



### Measurement

To operationalize the constructs in this study, we adapted existing scales validated in the original UTAUT study (Venkatesh et al. 2003) to fit the technologies and organization in the current study. The changes thus related to the name of the system used in this study and the name of the organization and business unit, which were featured in the instructions associated with the survey. Consistent with the original UTAUT study, experience was measured by coding point of measurement as 1, 2 or 3 to reflect increasing experience. The only difference between the original UTAUT study and the current study is that voluntariness in this study was coded as a continuous variable using a 7-point Likert agreement scale, where 1 was mandatory and 7 was completely voluntary. This change was necessitated because, unlike the origin UTAUT study that was conducted in multiple organizations wherein the level of voluntariness of use varied across organizations, this study is conducted only in one organization and thus calls for us to rely on intra-organizational variance in voluntariness. The appendix shows the questionnaire items used in this study.

### RESULTS

We applied the same data analysis procedures that were reported in the original UTAUT study (Venkatesh et al. 2003). We used PLS to analyze the measurement properties of constructs that includes the estimation of internal consistency (reliability), convergent and discriminant validity of the scales. The measurement models were examined in the context of the structural models tested.

**Measurement Model**

Table 2(a) and Table 2(b) show the measurement model estimation for the U.S. and China, respectively.

**Table 2. Measurement Model Estimation**

**(a) U.S. Sample (N=149)**

	ICR	Mean	S Dev	PE	EE	SI	FC	Gdr	Age	Exp	Vol	BI	Use
PE	.90	4.88	1.10	.85									
EE	.90	4.67	1.33	.29***	.88								
SI	.84	4.32	1.05	.28***	-.14*	.82							
FC	.82	4.14	1.01	.15*	.28***	.23***	.85						
Gdr	NA	0.33	0.47	-.18**	-.28***	.25***	.09	NA					
Age	NA	40.22	10.51	-.20**	-.22**	.23***	-.18*	.08	NA				
Exp	NA	2.00	1.00	.14*	.25***	-.20**	.18*	.06	.10	NA			
Vol	.80	4.88	1.45	.04	.05	-.16*	.08	.02	.02	.05	.77		
BI	.92	4.07	1.44	.38***	.18**	.15*	.21**	-.19**	-.22**	.16*	.13*	.82	
Use	NA	12.22	6.55	.32***	.15*	.29***	.14*	-.15*	-.20**	.14*	.10	.44***	NA

**(b) China Sample (N=201)**

	ICR	Mean	S Dev	PE	EE	SI	FC	Gdr	Age	Exp	Vol	BI	Use
PE	.90	4.77	1.20	.84									
EE	.93	4.45	1.35	.31***	.84								
SI	.84	4.89	0.89	.30***	-.16*	.83							
FC	.84	4.40	1.09	.18*	.31***	.21***	.80						
Gdr	NA	0.35	0.48	-.19**	-.26***	.05	.04	NA					
Age	NA	38.44	10.02	-.22**	-.25***	.10	-.17*	.05	NA				
Exp	NA	2.00	1.00	.16*	.24***	-.22**	.15*	.03	.06	NA			
Vol	.79	5.20	1.01	.07	.06	-.10	.09	.06	.03	.04	.75		
BI	.94	4.07	1.44	.40***	.19**	.24***	.22**	-.21**	-.20**	.17*	.14*	.84	
Use	NA	13.44	7.33	.31***	.18**	.20**	.18**	-.18**	-.19**	.13*	.07	.46***	NA

*Notes:*

1. ICR: Internal consistency reliability.
2. Diagonal elements are the square root of the shared variance between the constructs and their measures; off-diagonal elements are correlations between constructs.
3. PE: Performance expectancy; EE: Effort expectancy; SI: Social influence; FC: Facilitating conditions; Gdr (0: men): Gender; Exp: Experience; Vol: Voluntariness of use; BI: Behavioral intention to use the system.

All internal consistency reliabilities (ICRs) were above .70. The inter-construct correlations were greater than the square root of the average variance extracted (AVE), supporting convergent and discriminant validity. The results associated with factor loadings and cross-loadings revealed a clean pattern, with all loadings being greater than .70 and all cross-loadings being lower than .35. Specifically, the factor structure indicated that the items loaded more strongly on their pre-specified constructs than they did on other constructs, and given that the loadings were above .70, convergent validity is established (Fornell and Larcker 1981). Results of similar analyses from subsequent time period also indicated an identical pattern. Due to the clean factor structure and remarkable consistency in results with the original UTAUT study on these validated scales, we do not report the details here.

**Structural Model**

UTAUT was estimated using data pooled across time. The bootstrapping method was applied to test the PLS model. Table 3(a) and Table 3(b) show the detailed model test results predicting intention and usage, respectively, including all lower-level interaction terms. The three columns of results show the comparison of results from the U.S for the original UTAUT, China for the original UTAUT and China for the revised UTAUT as proposed in this paper. Based on the variance explained, it is clear that our study conducted in the U.S. explained about the same amount of variance as was found by Venkatesh et al. (2003). In China, however, the variance explained by the original UTAUT, while impressive at 64% was still lower than our revised UTAUT that, in fact, had fewer terms. The revised UTAUT developed for the Chinese context explained as much as 68% of the variance. The results from Table 3(b) suggested a nearly identical pattern in both U.S. and China, with the variance in technology use that was explained being about 50% in both countries.

**Table 3. Structural Model Tests**

**(a) Dependent Variable: Intention**

	U.S.	China	
		Original UTAUT	Revised UTAUT
R <sup>2</sup>	.70	.64	.68
Adjusted-R <sup>2</sup>	.68	.62	.66
Performance expectancy (PE)	.15*	.13*	.15*
Effort expectancy (EE)	.03	.02	.01
Social influence (SI)	.02	.04	.05
Facilitating conditions (FC)	.03	.01	.02
Gender (GDR)	.00	.02	.03
Age (AGE)	.02	.01	.02
Experience (EXP)	.02	.01	.02

Voluntariness (VOL)	.01	.03	.04
PE X GDR	.01	.03	.04
PE X AGE	.05	.04	.04
GDR X AGE	.04	.03	.05
PE X GDR X AGE	.43***	.40***	.41***
EE X GDR	.01	.02	.02
EE X AGE	.05	.04	.03
EE X EXP	.01	.02	.01
GDR X AGE (included earlier)	Earlier	Earlier	Earlier
GDR X EXP	.01	.03	.02
AGE X EXP	.00	.02	.01
EE X GDR X AGE	.05	.04	.03
EE X GDR X EXP	-.06	-.07	-.06
EE X AGE X EXP	-.01	-.02	-.01
GDR X AGE X EXP	-.05	-.04	-.03
EE X GDR X AGE X EXP	-.24***	-.22***	-.23***
SI X GDR	.01	.04	NS—dropped
SI X AGE	.01	.03	NS—dropped
SI X EXP	.02	-.14*	-.30***
SI X VOL	.05	.05	NS—dropped
GDR X AGE (included earlier)	Earlier	Earlier	Earlier
GDR X EXP (included earlier)	Earlier	Earlier	Earlier
GDR X VOL	.00	.02	NS—dropped
AGE X EXP (included earlier)	Earlier	Earlier	Earlier
AGE X VOL	.01	.03	NS—dropped
EXP X VOL	.01	.04	NS—dropped
SI X GDR X AGE	.02	.01	NS—dropped
SI X GDR X EXP	.00	.02	NS—dropped
SI X GDR X VOL	.00	.04	NS—dropped
SI X AGE X EXP	.04	.01	NS—dropped
SI X AGE X VOL	.03	.02	NS—dropped
SI X EXP X VOL	.01	.02	NS—dropped
GDR X AGE X EXP (included earlier)	Earlier	Earlier	Earlier
GDR X AGE X VOL	.02	.04	NS—dropped
GDR X EXP X VOL	.02	.01	NS—dropped
AGE X EXP X VOL	.03	.02	NS—dropped
SI X GDR X AGE X EXP	.03	-.02	NS—dropped
SI X GDR X AGE X VOL	.02	.03	NS—dropped
GDR X AGE X VOL X EXP	.01	.00	NS—dropped
SI X GDR X AGE X VOL X EXP	-.25***	-.02	NS—dropped

**(b) Dependent Variable: Usage Behavior**

	U.S.	China
R <sup>2</sup>	.50	.49
Adjusted-R <sup>2</sup>	.49	.48
Behavioral intention (BI)	.47***	.46***
Facilitating conditions (FC)	.10	.08
Age (AGE)	.07	.04
Experience (EXP)	.05	.07
FC X AGE	.03	.02
FC X EXP	.02	.04
AGE X EXP	.00	.01
FC X AGE X EXP	.21**	.22***

*Notes:*

1. "Included earlier" indicates that the term has been listed earlier in the table, but is included again for completeness as it relates to higher-order interaction terms being computed. Grayed out cells are not applicable for the specific column.
2. \* p<.05; p<.01; p<.001.

Before discussing our hypotheses and the support for them, we note that the effects observed in our sample in the U.S. was identical to what was observed by Venkatesh et al. (2003). Specifically, the effect of performance expectancy on behavioral intention was moderated by gender and age, the effect of effort expectancy on behavioral intention was moderated by gender, age and experience, and the effect of social influence on behavioral intention was moderated by gender, age, experience and voluntariness. Also, the effect of facilitating conditions on use was moderated by age and experience. It should also be noted that in all these cases, the pattern was in the direction theorized in the original UTAUT paper (Venkatesh et al. 2003).

As theorized, in China, the effect of performance expectancy on behavioral intention was moderated by gender and age such that it was strongest among younger workers, particularly men, thus supporting hypothesis 1a. Also, in China, the effect of effort expectancy on behavioral intention was moderated by gender, age and experience, such that it was strongest among older women in the early stages of experience, thus supporting hypothesis 1b. Further, in China, the effect of facilitating conditions on technology use was moderated by age and experience, such that the effect was strongest among older workers with increasing experience, thus supporting hypothesis 1c. Hypothesis 2 argued that in China, the effect of social influence on behavioral intention will be moderated by experience, such that the effect will be strongest for workers in early stages of experience. As we can see from Table 3(a), the 5-way interaction of social influence, age, gender, experience and voluntariness as theorized in the original UTAUT was not significant in China, but the interaction of social influence and experience that we had theorized was indeed significant (where non-

significant interaction terms were dropped) is significant, thus supporting hypothesis 2. We confirmed these patterns using split-sample analyses and interaction plots.

## **DISCUSSION**

### **Summary of Key Findings**

This research seeks to extend our understanding of technology adoption in different cultural contexts by extending UTAUT to China. We theorize the same relationships as those theorized in the original model with respect to the effects of performance expectancy, effort expectancy, and facilitating conditions on behavioral intention and/or technology use. As theorized, we found the effect of performance expectancy on behavioral intention varied across gender and age, such that the effect was strongest for younger men. The effect of effort expectancy on behavioral intention varied across gender, age and experience, such that the effect was strongest for older women in early stages of experience. The effect of facilitating conditions on technology use varied across age and experience, such that the effect was strongest for older workers at the later stages of experience. Regarding social influence, we theorize a different relationship in China from what is proposed and established in the original UTAUT study. As theorized, the effect of social influence on behavioral intention was moderated by experience, such that the effect was stronger for workers with increasing experience. The moderating role of gender, age and voluntaries were non-significant in China. In comparing the variance explained across U.S. and China, UTAUT explained about 70% of the variance in behavioral intention, much like the original UTAUT study, but explained “only” 64% of the variance in behavioral intention in China. But, the more interesting pattern was that the revised UTAUT with far fewer interaction terms explained 68% of the variance in behavioral intention in China. This indicates UTAUT does not work exactly the same in China as it does in the U.S., and confirms the important role of national culture in the context of this theory.

### **Theoretical Contributions**

Our paper makes a few important contributions to research. First, this is one of the first studies that *faithfully* replicate UTAUT in another country. Based on the citation count of web of science, UTAUT has been cited over 450 times since its publication in 2003. Our review indicated there are many studies that sought to understand the generalizability of UTAUT by replicating it in different countries (e.g., Al-Gahtani et al. 2007). However, none of the studies have replicated the model faithfully. For instance, limitations of prior replications include only partial of the models, measurement of constructs using scales that are different from the original UTAUT study, and not including contingencies. In this study, the whole UTAUT was replicated such that all constructs, including all contingencies, were measured in

exactly the same way as they were in the original study. In addition, our work is a longitudinal study like the original UTAUT study. Like the original study, we have 3 points of data collection before and after the system implementation, with one of these measurements occurring immediately after training.

Second, our paper contributes to IS research on culture. Many IS researchers have indicated the importance of culture in IS research (e.g., Kappos and Rivard 2008; Leidner and Kayworth 2006; Watson et al. 1997), with the relationship between culture and IT adoption, diffusion, and use being identified as one of the most important topics (Leidner and Kayworth 2006; Mao et al. 2005; Subramanian 2006). Only a few studies have sought to understand the role of culture as it relates to technology adoption (e.g., Gefen and Straub 1997; Srite and Karahanna 2006; Zhang and Maruping 2008) and the role of culture in affecting technology adoption has not been fully understood. Our work advances knowledge in this area. Specifically, this research extends our understanding on culture and technology adoption by focusing not only on cultural differences, but also on cultural similarities.

Third, our paper seeks to understand a boundary condition related to technology adoption research in general and UTAUT in particular. Our study found UTAUT does not work exactly the same way in China as it does in the U.S. The effect of social influence in China is different from what is theorized and observed in the U.S., indicating culture is an important contingency factor in the study of technology adoption. Identifying and understanding the role of such contingency factors is critical because the generalizability of any stream or a particular theory research hinges on properly outlining the boundary conditions (Lee and Baskerville 2003). However, our study only examined the cultural differences between the U.S. and China, with a particular focus on individualism/collectivism. Only through continued examination of UTAUT in other countries, e.g., India, will we be able to understand the potential role of the range of other cultural factors that could potentially alter the theorized relationships in the original UTAUT. Of course, a study of UTAUT using espoused cultural values could also be of immense value (Srite and Karahanna 2006)

## **Future Research**

Considering the significant role culture plays in technology adoption and use and the limited research that has examined this topic, we identify specific areas for future research to better understand the relationship between IS and culture. Given that the interplay between culture and technology adoption is complicated, future research should aim to advance our understanding in this area by refining the current study. Although we acknowledge the important role of culture in affecting technology adoption, we did not explicitly measure cultural values, such as collectivism/individualism, the major mechanism we used to make the argument on the different roles of social influence in the two countries where we conducted the study. Future research should operationalize this cultural mechanism such that its role

can be empirically validated. While the focus of current study is the moderating role of national culture, future research should examine other competing theoretical models, such as examining the direct effect of culture or understanding how it would play out in a mediational model. In addition, future research should capture other cultural dimensions, such as masculinity/femininity, power distance, uncertainty avoidance and long term orientation. For example, future research can examine the role of uncertainty avoidance because the implementation of new technology is likely to be accompanied by uncertainty and that cultural value could play an important role in affecting technology adoption. Finally, future research should examine the role of culture at the individual level. It is important to understand how individuals' value systems shaped by cultural values would affect their behaviors. Little research has examined cultural values at the individual level in technology adoption (for exceptions, see Sririte and Karahanna 2006; Zhang and Maruping 2008) and future research should advance our understanding of this topic.

### **Practical Implications**

Culture has been identified as a key issue in both management and IS research. However, research in both disciplines mainly focuses on the dissimilarities of different cultures so as to inform practitioners so they may acknowledge and address such differences. In this research, we not only acknowledge cultural differences, but also discuss cultural similarities. We found the effects of performance expectancy, effort expectancy, and facilitating conditions are indeed quite similar in both the U.S. and China, but the effect of social influence is not the same. Acknowledging cultural similarities is as important as identifying, understanding and acknowledging differences. For example, in a cross-country implementation of technology (e.g., in China and the U.S.), an organization can implement the same strategy of providing facilitating conditions, instead of applying different strategies that are likely to require additional resources or money.

One of our major findings in this study hinges on the idea that due to the collective culture in China, the effect of social influence is different in China from what is observed in the more individualistically-oriented U.S. Specifically, the effect of social influence in an individualistic culture is found to be tied to multiple contingencies but its effect in a collectivistic culture is found to be somewhat more monolithic in terms of contingencies. Therefore, multinational organizations should acknowledge the differential impacts of social influence across countries with regard to new technology implementations. For example, organizations in the U.S. need to consider the roles of gender, age, and mandatory vs. voluntary settings in addition to experience because these factors are pertinent to the role of social influence in affecting technology adoption in individualistic cultures. However, in China, the complexities and considerations related to this are irrelevant and the focus needs to be only on experience as it relates to the role of social influence and thus, early training in China can be approached quite uniformly across employees.

Acknowledging the influence of culture will facilitate cross-cultural collaboration and coordination, which could be critical in the implementation of new technology in different countries of a multinational corporation. For example, the implementation of a new technology may require employees in both China and the U.S. to use the technology to collaborate and coordinate. Ensuring employees in both countries have the appropriate culture-relevant training and support can create the appropriate mental models for employees in both countries in terms of how to use the technology to share knowledge and resolve task-related problems. This would suggest not using the same training materials but customizing the materials with a focus on attributes relevant in each culture.

## **CONCLUSIONS**

This paper extends research on technology adoption and use by discussing the generalizability of a key integrative technology adoption model, i.e., UTAUT, in two different cultural contexts, i.e., U.S. and China. Our study found culture does play an important role in affecting technology adoption. Specifically, the role of social influence varied across these two countries while the effects of other factors did not change. Our study suggests the importance of incorporating culture in technology adoption is important both from a scientific and practical standpoint. In response to the calls of other researchers for work on culture in the context of IS theories, we demonstrate the role of culture and limits of generalizability of a key IS theory.

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## **APPENDIX**

### Performance expectancy

I would find the system useful in my job.  
Using the system enables me to accomplish tasks more quickly.  
Using the system increases my productivity.  
If I use the system, I will increase my chances of getting a raise.

### Effort expectancy

My interaction with the system would be clear and understandable.  
It would be easy for me to become skillful at using the system.  
I would find the system easy to use.  
Learning to operate the system is easy for me.

### Attitude toward using technology

Using the system is a bad/good idea.  
The system makes work more interesting.  
Working with the system is fun.  
I like working with the system.

### Social influence

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.  
The senior management of this business has been helpful in the use of the system.  
In general, the organization has supported the use of the system.

Facilitating conditions

I have the resources necessary to use the system.  
I have the knowledge necessary to use the system.  
The system is not compatible with other systems I use.  
A specific person (or group) is available for assistance with system difficulties.

Self-efficacy

I could complete a job or task using the system...  
If there was no one around to tell me what to do as I go.  
If I could call someone for help if I got stuck.  
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.

Anxiety

I feel apprehensive about using the system.  
It scares me to think that I could lose a lot of information using the system by hitting the wrong key.  
I hesitate to use the system for fear of making mistakes I cannot correct.  
The system is somewhat intimidating to me.

Behavioral intention to use the system

I intend to use the system in the next <n> months.  
I predict I would use the system in the next <n> months.  
I plan to use the system in the next <n> months.