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American and Chinese Students and Acceptance of Virtual Reality: A Replication of "The Role of Espoused National Cultural Values in Technology Acceptance"

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Abstract:

The Technology Acceptance Model (TAM) and later versions (such as the Unified Theory of Acceptance and Use of Technology (UTAUT)) are among the best-known theories in the academic information systems (IS) field. The explanatory ability of TAM and related theories has been tested in various contexts, including national culture. The purpose of this study was to conduct a methodological replication of one of the most widely cited *MIS Quarterly* papers on TAM and national culture, by Srite and Karahanna (2006). Two differences in the original study and our replication were the sample (consisting of students in a U.S. university in the original vs. students in one U.S. and one Chinese university in the replication) and the technology object (personal computers and digital personal assistants in the original vs. virtual reality in the replication). We were not able to replicate the findings of the original study. Use of the original measurement scales resulted in different outcomes in the replication, and none of the hypotheses supported in the original work were supported in the replication. We report here on our data collection, methods, results, and findings.

Keywords: national culture, technology acceptance model, methodological replication

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1 Introduction

Information technology is widely used in today's business world to achieve "efficiencies, coordination and communication" (Srite and Karahanna, 2006). Previous studies have suggested that people's acceptance of new technology may vary according to their culture and that behavioral models do not hold across cultures. Motivated by those studies, Srite and Karahanna (2006) included espoused national cultural values as a construct in the extended technology acceptance model (TAM). They sought to examine the moderating effects of espoused national cultural values, at the individual level, on the acceptance of information technology. They conducted two studies in an American university to empirically test the proposed model. The first study investigated the usage of personal computers (PCs) among students from 30 countries studying at the university, and the second study focused on personal digital assistants (PDAs) among MBA students in the same university. The main contributions of Srite and Karahanna's (2006) research were the following: (1) extending the research on culture and technology acceptance by proposing that national culture impacts technology acceptance through influencing individually-held cultural values; and (2) furthering people's understanding of technology acceptance by adding espoused national cultural values to the TAM model.

The purpose of our study is to replicate Srite and Karahanna's (2006) studies. Rather than a literal replication, our study is a methodological replication. We collected data in two countries (U.S. and China) which vary widely on espoused national culture, and we asked about the use of virtual reality (VR) applications in education, rather than the use of PCs and PDAs. The objects of study in the original studies are no longer novel, and in the case of PDAs, even obsolete. Instead, virtual reality technology, an emerging technology with application in education, is novel enough in this context to be salient for a technology acceptance study. As we know, VR has shown that it has potential to change the way of learning and teaching by adding more vivid experiences (images, videos, immersive experience) to the traditional educational approach (Cipresso, Giglili, Raya & Riva, 2018). Therefore, the motivation of our study is to test the validity and generalizability of the model and measures proposed by Srite and Karahanna (2006) with a new but not unknown technology, with a sample drawn to sharpen contrasts in espoused national culture. The paper is structured as follows. First, we discuss the literature and relevant concepts in the original study. Second, we introduce our hypotheses, which are identical to those of the original paper. Third, we describe how we collected, processed and analyzed the data. Finally, we present our results and discuss their implications.

2 Theoretical Framework and Hypotheses

Motivated by research that behavioral models do not universally hold across cultures, Srite and Karahanna (2006) tried to determine how espoused national cultural values at the individual level affect the acceptance of information technologies. They measured four national cultural values taken from Hofstede's work: masculinity/femininity, individualism/collectivism, power distance, and uncertainty avoidance (Hofstede, 1980; Dorfman and Howell, 1988). They examined whether these four values moderated the relationships between behavioral intention and three antecedents taken from the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980) and the Technology Acceptance Model (TAM) (Davis, 1989) (perceived usefulness, perceived ease of use, and subjective norms).

Others have investigated the role of culture on technology acceptance. Several studies have compared the applicability of TAM across cultures or within a specific non-U.S. culture. For example, Straub, Keil and Brenner (1997) found that TAM held for U.S. and Swiss samples but not for Japanese participants. McCoy, Everard, and Jones (2005) found that TAM held equally well for samples from the U.S. and from Uruguay. Al-Gahtani, Hubona and Wang (2007) found that the unified theory of acceptance and use of technology (UTAUT) held for a sample of 722 knowledge workers in Saudi Arabia. Im, Hong and Kang (2010) found the effects of effort expectancy on behavioral intention and the effects of behavioral intention on use behavior differed between Americans and Koreans. Other studies have found technology use differences between cultural groups without using the TAM/UTAUT lens. Choe (2004) demonstrated that employees in different countries provided different amounts of information via management accounting information systems. Korean firms provided more flexibility performance information, while Australian firms provided more quality performance and traditional cost control information. Also, Kim, Sohn and Choi (2010) found that the differences in motivations for using social network sites between American and Korean college students could be explained by cultural differences.

2.1 Original Study Hypotheses

We list here the original hypotheses from the Srite and Karahanna (2006) paper:

H1a: The relationship between perceived usefulness (PU) and behavioral intention to use is moderated by the espoused national cultural value of masculinity/femininity such that the relationship is stronger for individuals with espoused masculine cultural values.

H1b: The relationship between perceived ease of use (PEOU) and behavioral intention to use is moderated by the espoused national cultural value of masculinity/femininity such that the relationship is stronger for individuals with espoused feminine cultural values.

H1c: The relationship between subjective norms (SN) and behavioral intention to use is moderated by the espoused national cultural value of masculinity/femininity such that the relationship is stronger for individuals with feminine cultural values.

H2: The relationship between subjective norms (SN) and behavioral intention to use is moderated by the espoused national cultural value of individualism/collectivism (IC) such that the relationship is stronger for individuals with collectivistic cultural values.

H3: The relationship between subjective norms (SN) and behavioral intention to use is moderated by the espoused national cultural value of power distance (PD) such that the relationship is stronger for individuals with higher power distance cultural values.

H4: The relationship between subjective norms (SN) and behavioral intention to use is moderated by the espoused national cultural value of uncertainty avoidance (UA) such that the relationship is stronger for individuals with higher espoused uncertainty avoidance cultural values.

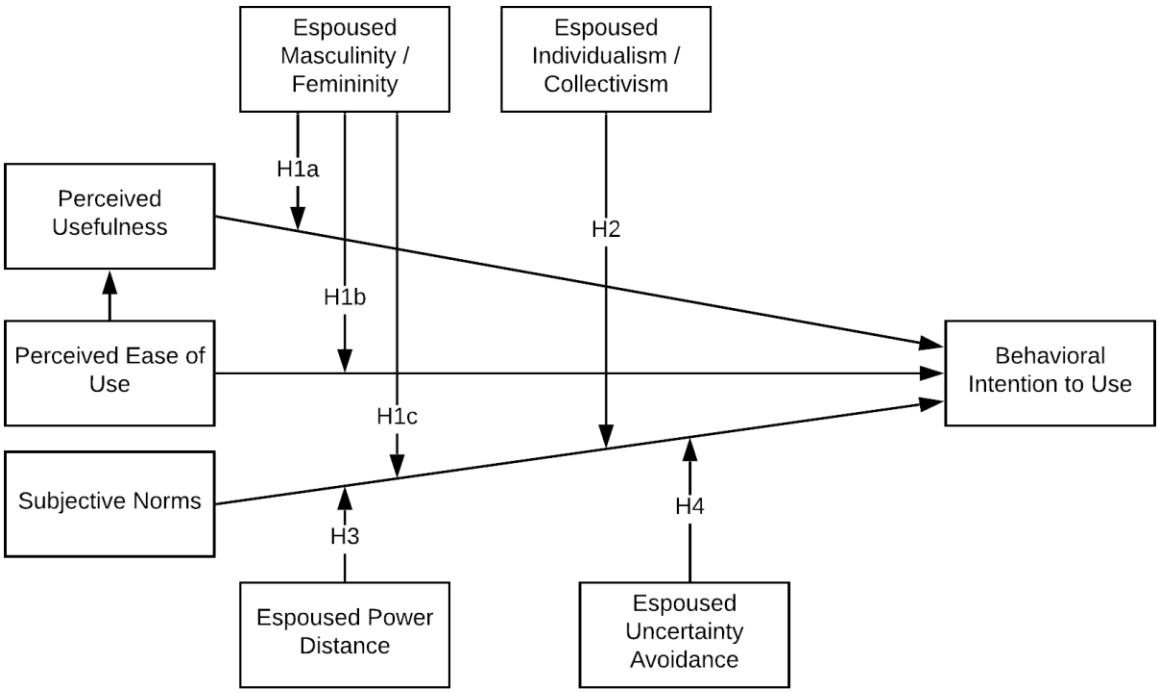


Figure 1: Research Model

3 Method

We applied the same research model (extended TAM – Figure 1) and the same data collection method (survey) as the original Srite and Karahanna (2006) studies. However, our replication was not exact. Instead, we conducted a methodological replication. Like Srite and Karahanna, we employed students in our study, but unlike them, our study participants did not all come from the same university. In fact, our

participants came from two separate universities in two different countries, the U.S. and China. As their studies were about espoused national culture, we wanted to increase the expected variance in our sample by drawing participants from two countries that differ widely on Hofstede's cultural dimension scales. Table 1 shows how the U.S. and China differ, according to https://www.hofstede-insights.com/product/compare-countries/. We also changed the technology object, from personal computers and personal digital assistants in the original studies to virtual reality. The previously used technologies were either too pervasive currently (personal computers) to consider in a study of technology acceptance or were obsolete (personal digital assistants). Instead, we decided to use an information technology which is the early stages of being used in business education.

Although virtual reality in its current manifestation is relatively new, it is not unknown to today's college students. In fact, it is more popular in China than it is in the west. Chinese students routinely visit VR pods or VR cafés, where they can experience VR without having to invest in the hardware (Hanson, 2016). It is projected that over 86 million VR headsets will be in use in China by 2021, with content revenue of $3.6 billion USD (Soo, 2017). Total VR revenue in China was 3.5 billion renminbi (500 million USD) in 2016 and is projected to reach 79 billion renminbi ($11 billion USD) by 2021 (Statistica Research Department, 2019). MarketWatch reports that 171 million people used VR worldwide in 2019 and that the total VR and AR (augmented reality) market will grow from $6.1 billion USD in 2016 to $160 billion USD in 2023 (Dujmovic, 2019). Forbes (Rogers, 2019) predicts "Growth is forecast across all regions and countries, with China leading the way." While the current use of VR in business education is in its early stages, it will most likely grow at the same rate as VR generally.

Table 1: National cultural dimension measure for U.S. and China

	U.S.	China
Individualist/collectivist	91 (individualist)	20 (collectivist)
Power distance	40 (low)	80 (high)
Masculinity/femininity	62 (masculine)	66 (masculine)
Uncertainty avoidance	46 (below average)	30 (low)

We designed an online survey, administered in Qualtrics, using the exact same items for extended TAM and for Hofstede's cultural dimensions as Srite and Karahanna (2006) (Appendix A). The survey included three sections: culture, acceptance, and demographics. There were 34 items in the culture section, 14 items in the acceptance section, and three items in the demographics section. All of the items in the culture and acceptance sections used seven-point Likert scales, ranging from 1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, to 7=Strongly Agree. The culture items had been translated previously into Chinese for another study (Furner and George, 2012). One of the authors checked and edited the items before use for this study. The remaining items were translated from English to Chinese and reviewed by two of the authors. Participants could access the Qualtrics-based survey in March 2019. Students at both universities received class credit for participating.

We received 190 responses from Chinese participants, and 128 responses from American participants. We removed one Chinese response, as the respondent self-identified as an American, and we removed 53 that were incomplete, leaving a total of 136. We removed 16 responses from the American university for respondents that did not self-identify as Americans, and we removed six incomplete responses, leaving a total of 106. For the remaining sample of 242, 38% were male, 58% were female, and 4% preferred not to say. For the Chinese subsample, 27% were male, 68% were female, and 5% preferred not to say. For the American subsample, 53% were male, 44% were female, and 3% preferred not to say. The average age for both subsamples was 22 years old. For comparison, Srite and Karahanna reported the following demographic data for gender and age: Study 1: 45.55% male; 54.45% female; average age of 25.48; Study 2: 55.2% male, 44.8% female; average age of 24.66. Note that they surveyed a mix of undergraduate and graduate students in Study 1, while all of their participants in Study 2 were MBA students. We only surveyed undergraduates, so our average age is less.

4 Results

4.1 Measurement Validity

Srite and Karahanna (2006) used established measurement scales for culture (Dorfman and Howell, 1988; Hofstede, 1980) and for technology acceptance (Davis, 1989), so we subjected the scales to confirmatory factor analysis (CFA) using AMOS (version 25). Just as the culture scales demonstrated some

psychometric issues in the original two studies, we noted some related issues. Table 2 shows the results of the four CFA tests run with AMOS for the culture scales. Each scale was tested as a separate model. For a good fit, the chi-square statistic should not be statistically significant, and the RMSEA value should be below 0.05. The only complete scale that met these criteria was that for masculinity/femininity. The scale for power distance was close, but four of the items had weights below 0.5 (although two were very close at 0.49). In the next step, items were dropped for power distance (PD5 and PD6), uncertainty avoidance (UA4 and UA5; At least four items are needed for CFA analysis in AMOS, so two items were dropped instead of three), and individualist/collectivist (IC1 and IC2). The resulting weights and fit statistics are shown in Table 3.

Table 2: Results of AMOS CFA tests for four national cultural dimensions

Item	Weight	Item	Weight	Item	Weight	Item	Weight
PD1	.65	UA1	.68	MF1	.70	IC1	.81
PD2	.71	UA2	.65	MF2	.59	IC2	.93
PD3	.49	UA3	.53	MF3	.80	IC3	.40
PD4	.49	UA4	-.09	MF4	.53	IC4	.36
PD5	.36	UA5	.23	MF5	.63	IC5	.13
PD6	.25	UA6	-.17			IC6	.11
PD7	.55						
Chi^2 (*df*)	22.993		26.591		5.822		80.621
Chi^2 p	.060		.002		.324		.000
RMSEA	.050		.087		.025		.176

Note: PD = power distance; UA = uncertainty avoidance; MF = masculinity/femininity; IC = individualist/collectivist

Table 3: Results of second AMOS CFA tests for three cultural dimensions

Item	Weight	Item	Weight	Item	Weight
PD1	.65	UA1	.68	IC3	.68
PD2	.71	UA2	.65	IC4	.64
PD3	.51	UA3	.55	IC5	.48
PD4	.49	UA6	-.17	IC6	.26
PD7	.56				
Chi^2 (*df*)	11.1		2.521		0.184
Chi^2 p	.050		.283		.912
RMSEA	.069		.032		.000

All three scales showed much better fit after pruning. However, the weights for UA6 and IC6 remained problematic. Scale reliabilities using the remaining items were estimated with the Cronbach's alpha procedure. The results were .782 for masculinity/femininity; .712 for power distance; .638 for uncertainty avoidance if UA6 were dropped; and .624 for individualist/collectivist if IC6 were dropped. A factor analysis test with all remaining items for all four scales, with varimax rotation, resulted in a solution with four factors, with each item loading on the appropriate factor. Table 4 contains the comparisons of culture scale constitution for our study and for the original.

We also ran CFA tests for the two reflective acceptance scales, PU and PEOU. (We could not run a CFA for intention, as the scale had only two items, nor could we run a CFA in AMOS for subjective norms, as that was modeled as a formative construct). The results of the tests are shown in Table 5. The fit statistics were not acceptable for either scale. Accordingly, we dropped the item in each scale with the lowest weight (shaded in Table 5). Given that only three items remained for each scale, we could not run any more CFA tests. However, we did calculate reliability statistics for the remaining items using the Cronbach's alpha procedure. The results were as follows: .869 for perceived usefulness and .718 for perceived ease of use. Srite and Karahanna (2006) used all four items for the perceived usefulness and perceived ease of use scales in their analyses. For subjective norms, they only used one item, for professors, in study 1, and two items, relatives and friends, in study 2.

Table 4: Comparison of valid measures for cultural dimension scales for original study & replication							
Power distance		**Uncertainty Avoidance**		**Masculine/Feminine**		**Individual/Collective**	
S&K	**current**	**S&K**	**current**	**S&K**	**current**	**S&K**	**current**
PD1	PD1	UA1	UA1	MF1	MF1	IC1	IC3
PD2	PD2	UA2	UA2	MF3	MF2	IC2	IC4
PD3	PD3		UA3	*MF4*‡	MF3	IC3	IC5
PD4	PD4				MF4	IC4	
PD5	PD7				MF5	IC5	
PD6						IC6	
PD7							
‡ MF4 was dropped in S&K study 2							

Table 5: Results of AMOS CFA tests for two TAM constructs			
Item	**Weight**	**Item**	**Weight**
PU1	.78	PEOU1	.52
PU2	.76	PEOU2	.67
PU3	.87	PEOU3	.61
PU4	.85	PEOU4	.74
Chi^2 (*df*)	4.123		29.823
Chi^2 p	.127		.000
RMSEA	.064		.233

To validate the subjective norms scale, we ran the TAM model, with subjective norms, in SmartPLS 3.3.8. The weights for the four items making up the scale were .429 (relatives), .093 (friends), .381 (professors), and .301 (classmates). Bootstrapping (sample size of 1000) showed that the friends item was not statistically significant at the $p < .05$ level, while the relatives and professors items were. The final item, classmates, was significant at $p = .054$. Accordingly, the friends item was dropped. Given that subjective norms was a formative construct, a reliability value could not be calculated. The inter-construct correlations for all of the constructs used in the replication are shown in Appendix B.

4.2 Comparison of Srite and Karahanna's Results with the Replication's Results

The results from Srite and Karahanna (2006), for both of their studies, are presented in Table 6. They used PLS (PLSGraph) to test their measurement and research models. We used SmartPLS 3.3.8. We first tested the basic TAM model, with SN (because subjective norms were included in the original study), as Srite and Karahanna (2006) did for both of their studies (Table 6). (For the Srite and Karahanna Study 1, TAM with SN explained 35.3% of the variance. For Study 2, they don't specifically report the variance explained in their TAM with SN model.) We then tested the Srite and Karahanna (2006) model, but because SmartPLS does not allow the testing of moderation without also testing direct effects, we created the six moderators manually. For each of the two scales in an interaction, we multiplied the value of each indicator for one scale with every indicator for the other scale (Chin et al 2003). The results are shown in Table 6 and in Figure 2. We also ran the model according to the SmartPLS default, with both interaction and direct effects (Table 7).

4.3 Hypothesis Testing

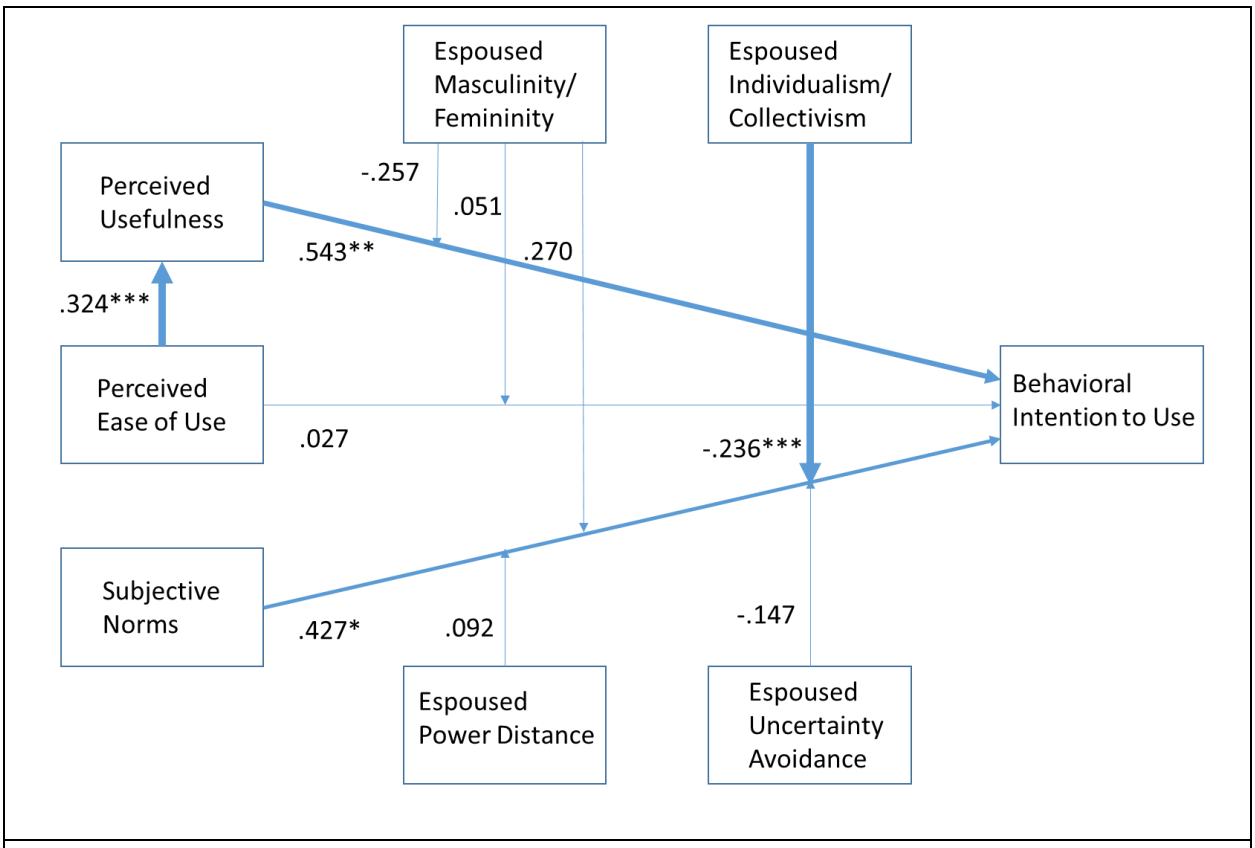
Each of the three studies that tested the Srite and Karahanna (2006) model found support for a different set of hypotheses (Table 8). Their Study 1 found support for H1c and H4, and their Study 2 found support for H1b and H4. Our replication found support for H2. Specifically, the relationship between subjective norms (SN) and behavioral intention was moderated by individualism/collectivism (IC), such that the relationship is stronger for individuals with collectivistic cultural values. Figure 3 shows the interaction between subjective norms and the individualist/collectivist dimension.

Table 6: Results from both Srite and Karahanna studies, TAM only replication, & replication with manually derived moderators									
		S&K study 1		S&K study 2		Our TAM only		Manual replication	
DV	**IVs**	**R2**	**B**	**R2**	**B**	**R2**	**B**	**R2**	**B**
Intention		.46		.60		.499		.529	
	PU		.290***		.338***		.408***		.543**
	PEOU		.294***		.127		.046		.027
	SN		.666***		.491**		.337***		.427*
	MFxPU		.042*		-.315				-.257
	MFxPEOU		-.492		.524*				.051
	MFxSN		-.319***		-.033				.270
	ICxSN		.140		.133				-.236***
	PDxSN		-.382*		.188				.092
	UAxSN		.530***		.469*				-.147
PU		.16		.21		.101		.101	
	PEOU		.403***		.458***		.324***		.324***
* p < .1; ** p < .05; *** p < .005									

Table 7: Replication results calculated for SmartPLS default moderation model.				
			SmartPLS Replication	
DV		**IVs**	**R^2**	**B**
Intention			.562	
		PU		.370***
		PEOU		.049
		SN		.274***
		MFxPU		-.035
		MFxPEOU		.117
		MFxSN		.022
		ICxSN		-.058
		PDxSN		.099
		UAxSN		-.029
		IC		-.202***
		MF		.079
		PD		.052
		UA		-.063
PU			.101	
		PEOU		.324***
* p < .1; ** p < .05; *** p < .005				

We found that the Chinese students were statistically significantly more collectivist (average of 3.9) on Hofstede's scale than were the American students (4.4), who were more individualistic. These findings are in line with Hofstede's general expectations on Chinese and American national culture. Substituting nationality for individualism/collectivism (Figure 4), we find a similar interaction as that shown in Figure 3. Collectivists who value the opinions of important others are more likely to accept a new technology, compared to other collectivists and individualists.

Table 8: Results of hypothesis testing for both original studies and for the replication.			
	S&K Study 1	**S&K Study 2**	**Current Study**
H1a			
H1b		Supported	
H1c	Supported		
H2			Supported
H3			
H4	Supported	Supported	



*** p < .1; ** p < .05; *** p < .005**

Note: The thickest lines indicate statistical significance at p < .005; the moderately thick line indicates significance at p < .05; the thinnest line indicates near significance at p < .1.

Figure 2: Evaluated Replication Model

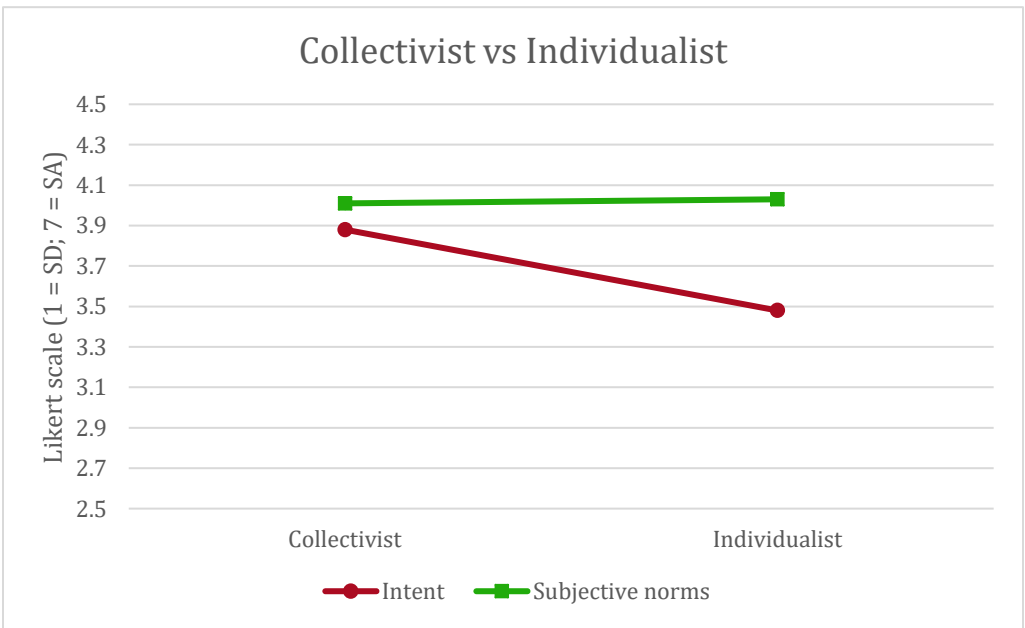


Figure 3: Interaction between collectivism/individualism and subjective norms on behavioral intention in the replication

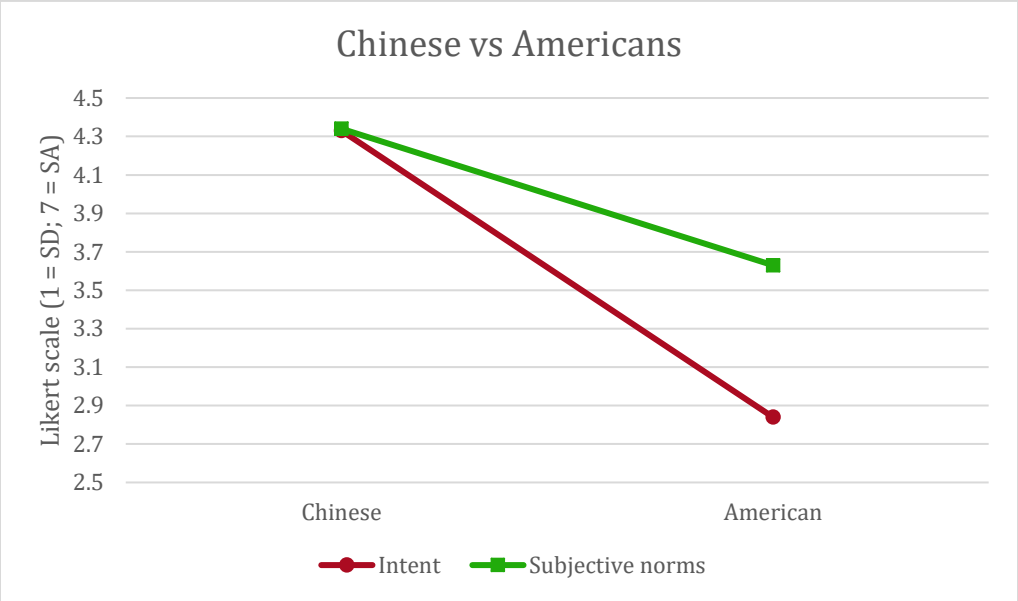


Figure 4: Interaction between nationality and subjective norms on behavioral intention in the replication

5 Discussion

Srite and Karahanna (2006), in their limitations section, call for their work "to be replicated to examine these findings across a wider range of individuals in different environments and with different technologies (p. 695)." We have done this, contrasting groups of Chinese and American students, with a focus on their intention to use virtual reality (VR) in their studies and college activities. In the same paragraph, they say "future research can engage in further development and validation for the cultural values scales to improve upon their psychometric properties." We have done this as well.

Like Srite and Karahanna (2006), we found strong support for the extended TAM model. In their two studies and in ours, perceived usefulness and subjective norms were strongly predictive of behavioral intention. In all three studies, perceived ease of use was strongly predictive of perceived usefulness. However, we were not able to replicate their findings regarding culture and technology acceptance. In fact, their own findings in this regard differed across studies. In their first study, they found the interactions between masculinity/femininity and subjective norms (H1c) and between uncertainty avoidance and subjective norms (H4) to be statistically significant. In their second study, they also found support for H4, but instead of support for H1c, they found support for the interaction between masculinity/femininity and perceived ease of use (H1b). (Their differences across studies could be due to different samples or different technology objects.) We found no support for the three hypotheses supported in their studies. Instead, we found the interaction between individualism/collectivism and subjective norms (H2) to be statistically significant.

The most likely reason we were not able to replicate the findings about culture and acceptance from the original studies has to do with the cultural dimension scales. Given the differences in how the items held together for Srite and Karahanna (2006) and for us, as well as in other studies that used the scales (Lewis, 2009; Furner and George, 2012; George et al 2018), there seem to be questions about their psychometric characteristics. Depending on the study, a scale may consist of all items or of some subset. Table 4 shows how the items that loaded on particular scales differed between their studies and ours. Given the discrepancies, one could even conjecture that we may not have been measuring the same things.

5.1 Decisions Made in Replications Affect the Outcomes

Every scientific study involves dozens or more decisions that affect the study's outcomes. Some are conscious, and some are not. As the authors of a National Academy of Sciences (2019) report on reproducibility and replicability say "When closely scrutinized, a scientific study or experiment may be seen to entail hundreds or thousands of choices, many of which are barely conscious or taken for granted (p. 41)." The decisions made in a replication of a study will rarely be the same decisions made by the original

researchers, partly because not every decision was deemed important enough to report by the authors and the review team. As a result, "When researchers investigate the same scientific question using the same methods and similar tools, the results are unlikely to be identical (National Academy of Sciences, 2019, p. 59)." Our attempted replication of the Srite and Karahanna (2006) may have turned out differently if we had made other decisions in our study design.

5.1.1 Control variables

One reason for the differences could be our decision not to use control variables in the analysis. In the original studies, experience was included in both analyses and was statistically significant in Study 2 but only marginally so in Study 1 (at the $p < .1$ level). Given the mixed findings in the original studies, and given the relative novelty of using virtual reality in business school studies, we declined to ask about experience.

5.1.2 Technology

Srite and Karahanna (2006) used two different technologies in their studies, personal computers and personal digital assistants. Although the first was ubiquitous at the time and the other was relatively rare, neither would be appropriate to ask about in today's technology environment. We decided to use an information technology that was novel but not unknown. We chose virtual reality. We could have chosen some other emergent information technology, but given the history of TAM and the well-established and recognized relationships between PEOU and PU and between PU and BI, it's not clear that using another emergent technology would have altered the outcome in terms of the TAM part of the model. A meta-analysis of TAM studies (Schepers and Wetzels, 2007) show that the correlations we found between PEOU and PU and between PU and BI are well within the range of correlations found in past TAM studies (Table 9).

Table 9: Correlation ranges of key TAM relationships compared to the present replication

Variable pair	Correlation range (S&W)	Percent significant	Current study correlations
PU & BI	0.24 to 0.75	100%	0.666
PEOU & BI	0.20 to 0.78	100%	0.317
SN & BI	0.15 to 0.75	86.36%	0.648
PEOU & PU	0.18 to 0.59	90.48%	0.324

5.1.3 Mandatory vs voluntary use

As was the case in both of the Srite and Karahanna (2006) studies, we chose a technology that was not mandated for student use. We could have chosen a technology that was mandated, and that might have made a difference in the TAM model outcomes. Initial tests of UTAUT showed that social influence (subjective norms) was more important to behavioral intent with mandatory use (Venkatesh, et al., 2003).

5.1.4 Sample and language

Another decision we made that differed from Srite and Karahanna (2006) was how we chose our sample. Rather than test the model with a group of undergraduate students from 30 cultures, or with a group of MBA students from unspecified cultures, we chose to test the model with respondents from two distinct cultural groups, Americans and Chinese. We did this to maximize the variance for each cultural dimension and to limit the number of cultures we were contrasting to two groups, where membership in each group and expectations about espoused cultural values were well defined. According to Hofstede (1980), Americans and Chinese nationals – as distinct groups – should differ on individualism/collectivism, power distance, and uncertainty avoidance (Table 1). Both cultures are seen as masculine (although we did find that our American respondents were a bit less masculine than our Chinese respondents were). Although we did find statistically significant differences for all four dimensions across groups, the key construct here seems to have been individualism/collectivism. While the differences in outcomes could have been predicted, based on the way samples were drawn, it would not have been predicted that the psychometric properties of the scales themselves would have varied so much across studies which drew different samples.

We also decided to translate our survey instrument into Chinese for our Chinese respondents. Srite and Karahanna (2006) did not translate their survey instrument into any of the native languages of their respondents, who came from 30 different countries, in their Study 1. The translation of the cultural items we used was originally created for another study (Furner and George, 2012), where the scales were translated into Chinese "with the help of three bilingual translators (p. 1433)." These scales were then

checked and edited by one of the Chinese authors of this paper. The TAM items used by Srite & Karahanna (2006) were translated into Chinese by the second Chinese author of this paper, and these items were then checked and edited by the first Chinese author. There is little doubt our findings would have been different had we given our Chinese participants an English survey instrument, but it also seems clear that the Srite and Karahanna (2006) results would have been different had they translated their instrument into each of the native languages of their participants. We know nothing about their respondents' native languages, their proficiency in English, or how these factors may have affected their responses.

5.1.5 Scale formation

The scales we used in this replication are well-established, so we conducted a CFA of both culture and TAM scales, using standard statistical practices. However, it seems clear that our measurements would have turned out differently had we not dropped the items that we did. It is not uncommon for researchers to include a troublesome item for theoretical reasons even if there are statistical reasons to drop it. To show how our scale formation affected our results, we conducted two post hoc analyses, one that included all items for all scales, and a second that included only those items that Srite and Karahanna (2006) themselves used in their scale development (see Table 4 for the cultural dimension items they used; they used all TAM items). The results are shown in Table 10. In both cases, the results differ very little from those of our manual replication (Table 6). The adjusted R^2 are very similar; the paths from PEOU to PU, from PU to BI, and the interaction of IC and SN are statistically significant. In the S&K indicators only model, the path from SN to BI is significant at $p < .05$; in the 'all indicators' model and in our manual replication, the path is marginally significant at $p < .1$. None of the other paths in any of the three models – and none of the other interactions – were statistically significant. Ultimately, the results across all three models were almost identical, regardless of which items were used in the evaluation

Table 10: Post hoc analyses including all scale items and those used by Srite & Karahanna (2006)

		All indicators		S&K indicators only	
DV	**IVs**	**R^2**	**B**	**R^2**	**B**
Intention		.512		.515	
	PU		.549**		.574***
	PEOU		-.001		.015
	SN		.330*		.406**
	MFxPU		-.237		-.313
	MFxPEOU		.060		.043
	MFxSN		.244		.294
	ICxSN		-.215**		-.198**
	PDxSN		.086		.105
	UAxSN		-.036		-.165
PU		.119		.119	
	PEOU		.350***		.350***
* p < .1; ** p < .05; *** p < .005					

6 Conclusions

At the beginning of the paper, we said that the main contributions of Srite and Karahanna's (2006) research were: (1) extending the research on culture and technology acceptance by proposing that national culture impacts technology acceptance through influencing individually-held cultural values; and (2) furthering understanding of technology acceptance by adding espoused national cultural values to TAM. Our replication of their work underscores their contributions, as we also demonstrated that espoused national culture affects technology acceptance in a TAM-based model. We found strong support for the role of the collectivist/individualist cultural dimension in explaining intention to supplement business studies with VR technology. Depending on the model we ran, collectivism/individualism either had a main effect or moderated the effect of subjective norms on intent. One reason the collectivist/individualist dimension played such a strong role, to the exclusion of the other three cultural dimensions, is no doubt because we deliberately chose our sample to enhance variance in that dimension, by choosing a sample made up of American and Chinese undergraduates. Our replication was methodological, intentionally sharpening differences in cultural dimensions by drawing a sample of American and Chinese students, and by using as the object of intention the use of virtual reality to support their studies and college activities.

Although we used the same measures, we did not get the same results as Srite and Karahanna (2006). We found support for only one of their original hypotheses. We could not replicate the findings from the original paper, which showed that social norms have a stronger impact on the intended behavior of individuals with feminine and high uncertainty avoidance cultural values, and that espoused masculinity/femininity values moderated the relationship between perceived ease of use and behavioral intention. The differences in outcomes are no doubt due to some of the decisions we made in designing our replication, not just sampling and technology object differences, but also not including a measure of experience, presenting the questionnaire in the native languages of our respondents, or in dropping scale items as a result of our CFA. Regarding the last point, however, our post hoc analyses demonstrated that our findings varied little with which scale items we did or did not include. The issues we (and others) faced with the cultural dimension scales indicate that there are some psychometric issues with the scales, and these issues probably contributed to the differences in outcomes. While our replication and both Srite and Karahanna (2006) studies demonstrated the generic role of cultural dimensions in a TAM model, all three studies clearly showed the impressive explanatory power of TAM in explaining behavioral intention.

7 References

Ajzen, I., & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Al-Gahtani, S.S., Hubona, G.S., and Wang, J. (2007). Information technology (IT) in Saudi Arabia: Culture and the acceptance and use of IT. *Information & Management* 44(8), 681-691.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, *14*(2), 189-217.

Choe, J. M. (2004). The consideration of cultural differences in the design of information systems. *Information & Management*, *41*(5), 669-684.

Cipressi, P., Giglioli, I.A.C, Raya, M.A., and Riva. G. (2018). The past, present, and future of virtual and augmented reality research: a network and cluster analysis of the literature. *Frontiers in Psychology, 9*, 2086. doi: 10.3389/fpsyg.2018.02086

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.

Dorfman, P. W., & Howell, J. P. (1988). Dimensions of national culture and effective leadership patterns: Hofstede revisited. *Advances in International Comparative Management*, *3*(1), 127-150.

Dujmovic, J. (2019). Opinion: Here's why you will be hearing more about virtual reality. *MarketWatch*. Retrieved from www.marketwatch.com/story/heres-why-you-will-be-hearing-more-about-virtual-reality-2019-07-15.

Furner, C. P., & George, J. F. (2012). Cultural determinants of media choice for deception. *Computers in Human Behavior*, *28*(4), 1427-1438.

George, J. F., Gupta, M., Giordano, G., Mills, A. M., Tennant, V. M., & Lewis, C. C. (2018). The Effects of Communication Media and Culture on Deception Detection Accuracy. *MIS Quarterly*, *42*(2), 551-575.

Hanson, L. (2016) China's year of virtual reality. *Forbes*. Retrieved from www.forbes.com/sites/lisachanson/2016/12/23/chinas-year-of-virtual-reality/#6290688e58b0).

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. Sage Publications, Beverly Hills, CA

Im, I., Hong, S., & Kang, M. S. (2011). An international comparison of technology adoption: Testing the UTAUT model. *Information & Management*, *48*(1), 1-8.

Kim, Y., Sohn, D., & Choi, S. M. (2011). Cultural difference in motivations for using social network sites: A comparative study of American and Korean college students. *Computers in Human Behavior*, *27*(1), 365-372.

Lewis, C.C. (2009). *To Catch a Liar: A Cross-Cultural Comparison of Computer-Mediated Deceptive Communication*. Unpublished doctoral dissertation, Florida State University.

McCoy, S., Everard, A., and Jones, B.M. (2005). An examination of the technology acceptance model in Uruguay and the US: A focus on culture. *Journal of Global Information Technology Management* 8(2), 27-45.

National Academies of Sciences, Engineering and Medicine. (2019). *Reproducibility and Replicability in Science*. Washington, D.C. The National Academies Press.

Rogers, S. (2019). 2019: The year virtual reality gets real. *Forbes*. Retrieved from www.forbes.com/sites/solrogers/2019/06/21/2019-the-year-virtual-reality-gets-real/#4a66c8376ba9.

Schepers J. and Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management* 44, 90-103.

Soo, Z. (2017). Chinese will use 86 million virtual reality headsets within five years. *South China Morning Post*. Retrieved from www.scmp.com/tech/social-gadgets/article/2097509/chinese-will-be-using-86m-virtual-reality-headsets-within-5.

Srite, M., & Karahanna, E. (2006). The role of espoused national cultural values in technology acceptance. *MIS Quarterly*, 30(3), 679-704.

Statistica Research Department. (2019). Virtual reality revenue in China 2016-2021. *Statistica*. Retrieved from https://www.statista.com/statistics/736532/virtual-reality-revenue-in-china/.

Straub, D., Keil, M. and Brenner, W. (1997). Testing the technology acceptance model across cultures: A three country study. *Information & Management* 33, 1-11.

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425-478.

Appendix A: TAM scales (in English) used in our study

Perceived Usefulness

PU1: Using a Virtual Reality device will enhance my productivity in college

PU2: I find Virtual Reality devices useful in my college activities

PU3: Using Virtual Reality devices enhances my effectiveness in college

PU4: Using Virtual Reality devices improves my performance in college

Perceived Ease of Use

PEOU1: It is easy for me to become skillful in using Virtual Reality devices.

PEOU2: I find Virtual Reality devices easy to use.

PEOU3: I find it easy to get a Virtual Reality device to do what I want it to do.

PEOU4: Learning to operate a Virtual Reality device is easy for me

Behavioral Intention to Use

BIU1: I intend to use a Virtual Reality device during my studies

BIU2: I intend to use a Virtual Reality device frequently during my studies

Subjective Norms (Normative Beliefs)

NB1REL: My relatives think that I should use a Virtual Reality device

NB2FRI: My friends believe I should use a Virtual Reality device

NB3PRO: My professors think I should use a Virtual Reality device

NB4CLA: I believe that my classmates at college think I should use a Virtual Reality device

Appendix B: Inter-Construct Correlations

	Mean	S.D.	IC	Intention	MF	PD	PEOU	PU	SN	UA
IC	4.16	1.04	0.716							
Intention	3.67	1.49	-0.253	0.923						
MF	2.75	1.11	0.027	0.156	0.731					
PD	3.01	0.95	0.111	0.215	0.366	0.670				
PEOU	4.44	1.02	0.03	0.317	0.055	0.088	0.795			
PU	4.32	1.22	-0.075	0.666	0.112	0.216	0.324	0.890		
SN	3.84	1.11	-0.056	0.648	0.070	0.162	0.393	0.717	NA	
UA	5.76	0.71	0.08	-0.16	-0.178	0.002	-0.023	-0.156	-0.087	0.720

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