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Exploring privacy paradox in information-sensitive mobile app adoption: A cross-cultural comparison

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ABSTRACT

This paper proposes and tests a conceptual model of private-information sensitive mobile app adoption utilizing privacy calculus approach. It also explores the role of personality in affecting perceived benefits of using mobile apps and compares the findings across two countries: the US and China. Irrespective of the cultural environment, millennial mobile app users download apps that require access to sensitive personal information in order to satisfy their informational and social (but not entertainment) needs. Perceived privacy concern does not influence adoption or future use of private-information sensitive apps. Extraversion and agreeableness are positively related to user perceptions of benefits obtained from using apps.

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1. Introduction

The rapid evolution of mobile technology from voice-based functionality to multimedia exchanges, commercial transactions, social networking and gaming has fueled the development of application (app) software to satisfy existing and potential needs of mobile users (TechCrunch, 2014). Marketers and advertisers increasingly embrace mobile apps for more precise targeting, customer service, and relationship management (IAB, 2015). In order to provide high quality, on-demand and context-aware services, apps contain features and functionalities that take into account users' location, personal preferences, gender, age, interests, and other personal data. The permissions to access private content (e.g. browser history, calendar events, pictures and contacts) required by various apps have exploded and led to greater security and privacy concerns (Olmstead, 2014). Many users perceive substantial threats because their personal information could be tracked by commercial entities, law enforcement, or malicious parties (Balebako et al., 2011). These concerns may amplify privacy considerations in consumer app selection and adoption decisions. According to the Pew Internet Project survey, 85% of adults believe it is "very important" to control access to their personal information. It is estimated that about 54% of users have refused to download an app and 30% of app users have deleted an app for privacy reasons. Additionally, one in five mobile app users have disabled the location tracking feature on their phone, and one in three regularly delete their cell phone browsing or search history entries (Boyles, Smith, & Madden, 2012).

Notwithstanding these explicit privacy concerns, some scholars argue that consumers are still willing to disclose sensitive personal details in exchange for more customized mobile services that provide interesting and relevant information, connectivity, and instantaneous problem solving (Magedanz & Simões, 2009). A similar phenomenon, identified as "privacy paradox", has been reported in social media use (Barnes, 2006). For instance, despite reporting concerns over disclosure of private data, over 90% of Facebook users disclose their real name, birth date, high school, profile picture, and email address (Stutzman, Capra, & Thompson, 2011). Apparently, the needs for impression management and relationship maintenance compel users to reveal extensive amounts of personal data, and account for the discrepancy between privacy concern and actual privacy protection behaviors. In an attempt to explain the inconsistency between expressed privacy concerns and actual sensitive-technology adoption behavior, the

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privacy calculus theory suggests that in the process of decision-making, consumers make mental tradeoffs between perceived benefits and perceived privacy risks. The actual behavioral outcome thus relies on the relative dominance of benefits vs. concerns (Dinev & Hart, 2006). Understanding whether privacy calculus operates in the context of mobile app adoption and identifying specific drivers and obstacles affecting the extent of mobile app adoption and usage can assist both app developers and businesses that increasingly rely on customer data in refining their marketing practices. However, very few papers to date have examined the interplay of perceived benefits and privacy concerns driving consumer decisions to download and continue using privacy-sensitive apps. Further, although cultural and personality differences were previously found to impact technology use (Devaraj, Easley, & Crant, 2008; Lane & Manner, 2011; Watson, Teck, & Raman, 1994), no extant research considers potential roles of personality traits and/or national culture in the tradeoff between benefits and privacy concerns for mobile app adoption and use.

To address these gaps in the literature, this paper applies the privacy calculus theory to propose and test a conceptual model of mobile app adoption (Dinev & Hart, 2006). We build on previous research suggesting that mobile app consumers make mental tradeoffs between their privacy/security concerns and perceived app benefits for actual adoption and use behaviors, and also explore the roles of personality factors in these relationships. In order to address inconsistent findings in different cultural contexts, the study tests the proposed relationships in the US and China, characterized by diverse approaches to conformity and security, as well as different extent of mobile app adoption (Cao & Everard, 2008). The remainder of this paper develops theoretical arguments and research hypotheses, reports results of a cross-cultural study, and discusses their implications for marketing theory and practice.

2. Theoretical development and hypotheses

2.1. Privacy calculus theory

Considered the most useful framework to study contemporary privacy perceptions, the calculus perspective of information privacy addresses joint effects of perceived benefits and risks on privacy perceptions and privacy-protective behaviors (Laufer & Wolfe, 1977). This theory suggests that the concept of privacy cannot be viewed as absolute, but is subject to interpretations of economic terms. The model assumes that individuals can have strong beliefs about costs and benefits of information disclosure simultaneously (Dinev & Hart, 2006). Usually behaving in ways maximizing positive outcomes and minimizing negative outcomes, individuals will disclose information in exchange for some economic or social benefits under the conditions that their personal information will be used fairly, with no negative consequences in the future. Privacy loss with information disclosure is acceptable, as long as it assures certain benefits, and the level of risk is moderate (Laufer & Wolfe, 1977).

While the privacy calculus model has been tested in several studies, existing research is overwhelmingly characterized by context-limited results, emphasizing roles of specific benefits vis-a-vis generalized concerns. For example, in utilitarian settings of online shopping and job hunting, perceptions of privacy concern were found to have a negative relationship with users' willingness to provide information and with their adoption of online services. At the same time, such benefits as personalization and compensation positively affected information disclosure (Culnan & Bies, 2003; Dinev & Hart, 2006; Yang & Wang, 2009). In the social media context, the benefits of perceived enjoyment, self-presentation, and relationship maintenance were associated with a higher level of information disclosure, outweighing the role of risk factors (Kim, Mirusmonov, & Lee, 2010; Krasnova, Spiekermann, Koroleva, & Hildebrand, 2010; Lee, Park, & Kim, 2013). In the context of mobile location services, Xu, Teo, Tan, and Agarwal (2009) identified positive relationship between financial compensation benefit and mobile app adoption only for "push" services (those proactively induced by the firm). Conversely, personalization benefit had a positive impact on location service adoption only if a consumer started the request for service by volunteering his/her information, but not when the firm covertly obtained this information (Xu, Luo, Carroll, & Rosson, 2011). Zhao, Lu, and Gupta (2012) found that users' privacy concerns and perceived benefits of personalization and connectedness jointly affected the intention to disclose location information.

The current study takes a broader approach and addresses the effect of perceived benefits on the quantity of mobile apps adopted and the extent of their use, as opposed to the earlier considered outcomes of a specific app adoption or a single disclosure behavior. We operationalize perceived mobile app benefits as subjective measures of usefulness or want satisfaction resulting from consumption and use of mobile apps (Zeithaml, 1988). These benefits incorporate, among others, timeliness and convenience, access to quality information, entertainment, and socialization (Lee, Goh, Chua, & Ang, 2010).

We define information privacy as the ability of individuals to control when, how, and to what extent their personal information is accessed (Smith, Milberg, & Burke, 1996). Concern for information privacy can then be defined as the individual's worries about information privacy practices by organizations, such as collection of personal information, unauthorized secondary use of personal information, errors in processing personal information, and improper access to personal information (Smith et al., 1996). Mobile apps downloaded on users' smart devices can detect location and time of day, presence of other connected individuals in the vicinity, browsing and networking patterns, and other sensitive data. These data can be sold to third parties (advertisers, government agencies, etc.) or hacked, potentially threatening one's security and leading to personally embarrassing situations. Therefore, it is logical that a user would be unlikely to adopt and use mobile apps if there is a chance of an opportunistic behavior by mobile service providers (Xu et al., 2011). Earlier research found that privacy concern influenced acceptance of technology and online purchase intentions (Smith, Dinev, & Xu, 2011). Direct negative impact of privacy concern was empirically supported for e-commerce (Dinev & Hart, 2004; Li, Sarathy, & Xu, 2010) and e-banking adoption behaviors (Jahangir & Begum, 2007). Additionally, in the context of social networks, users with higher privacy concern were reported to have more restrictive privacy settings for their profiles (Stutzman et al., 2011; UT & Kramer, 2009).

Based on the privacy calculus theory, we propose that users assess both the privacy risks and benefits to decide whether to adopt and use an information-sensitive mobile app. Specifically, the individual's overall assessment of the utility of mobile apps is more likely to motivate users to adopt and use the apps, while higher concern for information privacy will negatively affect the extent of adopting and using privacy-sensitive mobile apps.

H1. Perceived benefits are positively related to a) mobile apps use and b) intention to continue using mobile apps in the future.

H2. Privacy concern is negatively related to a) mobile apps use and b) intention to continue using mobile apps in the future.

2.2. Personality and privacy calculus

Reflecting a steady set of attributes and tendencies that determine commonalities and differences in thoughts, feelings, and

actions of individuals, personality dimensions are powerful predictors of users' attitudes and beliefs towards technology (Devaraj et al., 2008). Specifically, the Big Five personality factors (agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) account for most individual variations with respect to mobile technology use (Lane & Manner, 2011) and are associated with privacy-protecting behaviors in social media (Ryan & Xenos, 2011). Surprisingly, no research to date has assessed the role of personality in privacy calculus for adopting mobile apps. To address this gap, the following hypotheses are put forward, based on earlier findings in other technology adoption contexts.

Extraversion is a personality dimension linked to being warm, sociable and assertive (Anastasi & Urbina, 1997; Costa & McCrae, 1992). In the context of smartphone ownership, Lane and Manner (2011) found that extraverts were more likely to own a smartphone and use it for texting. They were also more likely to join social media (Ryan & Xenos, 2011) and disclose the most personal information (Hollenbaugh & Ferris, 2014; Loiacono, 2014). Extraverts were also reported to have lower information sensitivity concern, so as to accommodate their higher need to interact (Bansal & Gefen, 2010). Therefore, extraversion should positively affect the perceptions of mobile apps benefits and is negatively related to user privacy concerns. *Agreeableness* emphasizes trust, altruism, compliance and modesty (Anastasi & Urbina, 1997). Devaraj et al. (2008) found that agreeableness was positively associated with beliefs about usefulness of technology. Agreeable individuals are more likely to value technologies that encourage collaboration, cooperation, and task accomplishment. They are also more accommodating and cooperative. Thus, agreeable users should perceive greater benefits from downloading and using mobile apps. Agreeable individuals are also less likely to judge others' actions as potentially harmful when faced with privacy threats. Their tendency to trust and to be less suspicious of their environment may reduce their privacy concern. Consequently, they may have fewer privacy concerns. *Openness to new experiences* relates to an individual's fantasies, ideas, actions, feelings and values. Individuals scoring high on this personality trait tend to be less conforming to norms and to have untraditional and widespread interests (Anastasi & Urbina, 1997). They are also more likely to hold positive attitudes and cognitions toward accepting technology because they feel less threatened by change associated with new technology. Those high on openness to new experiences have a strong desire to experiment with varied things and attempt new approaches (Devaraj et al., 2008), are more capable at mitigating risks and therefore do not worry as much about information sensitivity (Bansal & Gefen, 2010). They are more sociable on Facebook (Ross et al., 2009) and tend to upload more pictures (Moore & McElroy, 2012). These findings lead to the supposition that individuals open to new experiences may perceive greater benefits of mobile apps and also experience fewer privacy concerns. *Neuroticism* is a personality dimension characterized by anxiety, self-consciousness and impulsiveness (Anastasi & Urbina, 1997), Ehrenberg, Juckes, White, and Walsh (2008) found that neurotic users spent more time text messaging and exhibit stronger mobile phone addictive tendencies. Additionally, less emotionally stable individuals tend to use technology as a substitute for traditional social interaction. Users characterized by high neuroticism are more likely to use the Internet for communication (Wolfradt & Doll, 2001) and to avoid loneliness (Butt & Phillips, 2008). They also post more accurate personal information in anonymous social media (Amichai-Hamburger, Wainapel, & Fox, 2002). However, more neurotic individuals are also more volatile and fearful in hazardous situations (Bansal & Gefen, 2010). Therefore, greater neuroticism may be associated with greater perception of benefits from mobile app download and use (e.g. satisfaction of the need to belong), while also increasing perceived privacy concerns due to their tendency to focus on negative events and possible losses. *Conscientiousness* is a personality dimensions that emphasizes competence, achievement, self-discipline and dutifulness (Anastasi & Urbina, 1997). Conscientious individuals carefully consider ways in which the use of technology would increase efficiency and are more likely to undertake new initiatives needed for successful completion of tasks (Devaraj et al., 2008), They are also more likely to consider the impact of their actions on others and to avoid using social media, potentially to dedicate more time to other pursuits (Ross et al., 2009). Conscientious individuals have more precaution and foresight, are detail-oriented, and investigate various consequences of a decision, as well as better able to identify potential hazards of disclosing private information (Bansal & Gefen, 2010). It appears that in as far as mobile apps provide affordances for efficient task completion, conscientious users would consider them beneficial. However, since conscientious individuals tend to be deliberative, give more attention to details and pay close attention to others' actions, they would also manifest greater concern for protecting their privacy. Based on the above, we hypothesize:

H3. Individuals characterized by high a) extraversion, b) agreeableness, c) openness to new experiences, d) neuroticism and e) conscientiousness would perceive greater benefits from adopting and using mobile apps.

H4. Individuals characterized by high a) extraversion, b) agreeableness, and c) openness to new experiences would express fewer privacy concerns regarding adopting and using mobile apps.

H5. Individuals characterized by high a) neuroticism and b) conscientiousness would express greater privacy concerns regarding adopting and using mobile apps.

2.3. Cross-cultural differences in privacy calculus

Prior studies have shown that mobile internet technology acceptance and use patterns in Taiwan, Korea and Hong Kong are different from those in Australia, Japan, Greece and Denmark (Lee et al., 2010). In a similar trend, information-sensitive app adoption represents a mainstream phenomenon in China, but has not reached such a broad scale in the US (Kim et al., 2010; Yang, Lu, Gupta, & Cao, 2012). Various factors, such as greater availability of low cost mobile gadgets, widespread use of social networks for mobile payments in China, as well as acceptance of inevitable government oversight of digital activities, may account for such differences. It is also plausible that cultural contexts can affect perceptions of benefits and concerns in privacy calculus, as well as potential differences in the dominant personality traits affecting perceptions of concerns and benefits. Culture, as a socialization context, plays an important role in individual perceptions of benefits and uses of technology. The role of culture in technology adoption and use has been empirically supported by a number of existing studies. For example, Straub, Keil, and Brenner (1997) posited that technology acceptance model dimensions such as perceived usefulness and ease of use differed vastly across cultures. In the mobile context, Meso, Musa, and Mbarika (2005) found that national culture had a strong impact on perceived usefulness and ease of use of mobile technology. Cao and Everard (2008) reported that espoused cultural values significantly influenced users ' perceptions of personal privacy and awareness, leading to their attitude towards using instant messaging. Based on the existing theories of cultural values (Hofstede, 1984; Schwartz, 1992), American and Chinese cultures differ on the dimensions of self-direction (emphasizing independent thinking and creativity),

conformity (restraining from actions that may violate expectations or norms), and security (placing a high priority on harmony and stability of group) (Schwartz, 1994). Therefore, we expect that mobile app users from Chinese and American cultures would differently approach the tradeoffs between mobile app benefits and privacy concerns. We also anticipate that different personality traits would be dominant in impacting perceptions of benefits and privacy concerns in these two cultures. However, due to lack of prior empirical findings in these areas, we do not advance specific hypotheses. Fig. 1 shows the hypothesized relationships for the study.

3. Method

3.1. Sampling and data collection

The study focuses on the millennial population in both countries because millennials represent the largest segment of global smartphone owners and mobile app users (Nielsen, 2014). In the US, the data were collected via an online survey of business students enrolled in a public university in the Midwest. An announcement offering bonus points and containing a link to the survey was posted on the Blackboard interface of five Marketing classes by two professors. The instructions to the survey asked respondents to answer the questions about their download and use of the personal information-sensitive apps (those that required permission to access user location, camera, address book, social media contacts, etc.). The survey link was available for three weeks. The survey was then translated into Chinese and back-translated into English to ensure comparability and equivalence in meaning (Brislin, 1970) before the link was distributed via e-mail by a Chinese professor to her students in a Southern university in exchange for bonus points. Using convenience sampling was deemed appropriate, since at this exploratory stage of the research we focused more on identifying and understanding the phenomenon as opposed to generalizing the findings to larger populations (McCracken, 1988). Additionally, this sampling method has low cost and provides easy access to target population. However, it is prone to self-selection bias, and warrants caution in generalizing the results (Erickson, 1979).

To measure perceived benefits of using mobile apps, we adapted an existing scale of "perceived gratification for retrieving mobile content" from Chua, Goh, and Lee (2012). The original scale consisted of four subscales: information resources/services, leisure, information quality, and socialization. However, the information quality subscale items were deemed too closely resemble the information benefit dimension and, after a discussion with five IT managers and three business executives from both countries, were excluded from the perceived benefits scale. Thus, the remaining three subscales retained in this study include information resources/services, leisure/entertainment, and socialization. The measure for perceived privacy concern was adapted from Hong and Thong (2013). The original scale had 18 items comprising six subscales. To reduce the questionnaire length, only one item with the highest loading in each subscale in the original study was chosen to measure perceived privacy concern for this study, for the total of 6 items. Previous research has shown that single-item scales have good reliability (Shamir & Kark, 2004), convergent validity (Robins, Hendin & Trzesniewski, 2001) and predictive validity (Bergkvist & Rossiter, 2007). The Ten-Item Personality Inventory (TIPI) was used to measure personality (Gosling, Rentfrow, & Swann, 2003). App use was operationalized by combining two formative indicators: the number of downloaded and used apps that required access to private data, and the total number of minutes spent on these mobile apps per day. Intentions to continue using mobile apps were measured by two items: "I will definitely keep using these mobile applications", and "I expect to be using these mobile applications in the future". All perceived benefits items were measured by a 5-point Likert scale where 1 was "strongly disagree" and 5 was "strongly agree". All other constructs were measured by a 7-point Likert scale where 1 was "strongly disagree" and 7 was "strongly agree".

Although private-information sensitive apps are developed for and used on other mobile devices, we limited our focus to smartphones in order to reduce potential variability in responses due to device specifics. While tablets and smartphones both represent dominant modes for mobile app access, the share of smartphones in mobile app usage time (82%) far exceeds that of tablets (ComScore, 2015). This can be attributed to both the greater number of apps available for smartphones and the larger screen size of tablets conducive to accessing various services via mobile web browsing as opposed to apps. Further, potential differences in perceived benefits and privacy concerns may manifest in the usage of different mobile-app compatible devices (e.g. smart watches vs tablets). For these reasons our study specifically addressed app use on the single dominant device, the smartphone. The respondent demographics in both sub-samples correspond to those of smartphone users, since in addition to being the largest segment of global smartphone owners (Nielsen, 2014) and the heaviest mobile app

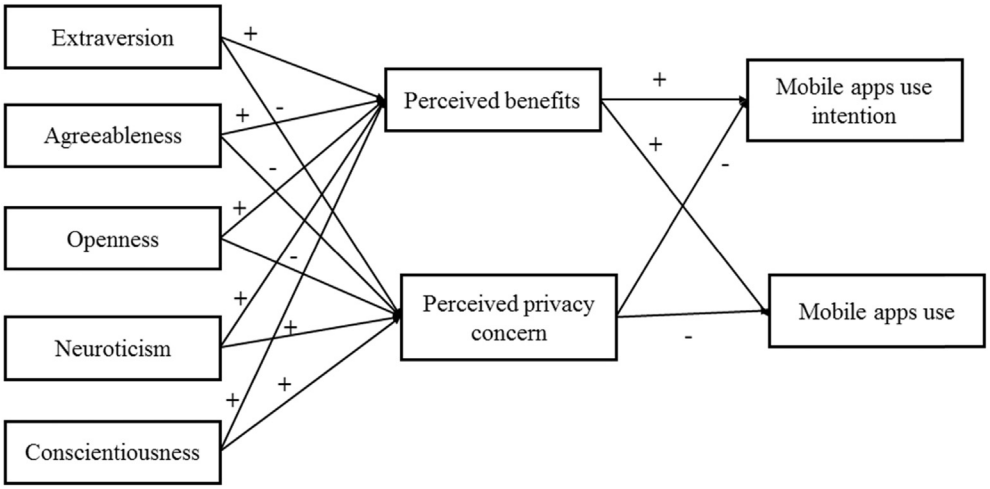


Fig. 1. Relationships proposed in the study.

users, millennials are second only to Generation Y in the amount of average time spent monthly on app usage (82.5 h) (ComScore, 2015).

Out of 130 collected responses from the American participants, 24 (18%) were incomplete or invalid and were eliminated. Similarly, 8% (27) of non-valid responses from the total of 147 Chinese participants were removed. After accounting for missing values, 106 American and 120 Chinese responses were retained. Table 1 lists the demographic information of the respondents, as well as characteristics of their mobile apps usage. We conducted Chi-square tests of independence to see if there is any difference in mobile app use between the two countries. Regarding minutes of using mobile apps each day, there is a relationship between country and the minutes spent on mobile apps (Chi square = 20.86, $p < 0.01$). In terms of mobile apps downloaded, Chi-square test statistics is 10.4 ($p < 0.1$), supporting that there is a relationship between country and number of mobile apps downloaded. The post-hoc tests shows that Chinese current use of privacy-sensitive mobile apps in terms of both the number of downloaded apps, and the time spent interacting with these apps was greater than that of the US users. A higher percentage of Chinese respondents spend more than two hours on mobile apps compared to their American counterparts. Further, a lower percentage of the Chinese download fewer than 15 mobile apps, but a higher percentage of the Chinese downloaded more than 45 apps than Americans.

3.2. Construct validity and reliability

Convergent and discriminant validity of the constructs was assessed by conducting an exploratory factor analysis, since the items measuring perceived privacy concern diverged from the established scale. All items measuring perceived benefits and perceived privacy concerns of using mobile apps were subjected to the maximum likelihood exploratory factor analysis with oblique rotation (Costello & Osborne, 2005). All resulting factor loadings were higher than the cutoff value of 0.5, with no cross-loadings of items above 0.4, which satisfies the criteria for convergent and discriminant validity (Hair, Black, Babin, Anderson, & Tatham, 2006). Construct reliability was measured by Cronbach alphas. As shown in Table 2, the Cronbach alphas of all constructs ranged from 0.87 to 0.93, exceeding the recommended minimum cut-off of 0.70 (Hair et al., 2006). Factor means and standard deviations are also reported in Table 2. The means of the factors were used in the subsequent analysis.

3.3. Comparison of respondents from two countries

Inter-cultural comparison showed that in terms of personality traits, Chinese respondents scored higher on agreeableness and neuroticism, but lower on extraversion, openness and conscientiousness compared to their American counterparts (Table 3). This is consistent with the earlier findings by Schmitt, Allik, Mccare, Benet-Martinez, and et al (2007) that East Asians score higher on neuroticism and lower on extroversion, conscientiousness and openness compared to North Americans. In our sample, Chinese users of information-sensitive apps value all the benefits afforded by these apps (informational, social, and entertainment) higher than their American counterparts, and are also marginally ($p < 0.1$) more concerned with their privacy (Table 3). On the other hand, the intention to use information-sensitive apps in the future was significantly higher for the US respondents (Table 3).

It is possible that the discrepancy between the current use and future intentions of the American and Chinese respondents can be explained by different dynamics of mobile app diffusion and retention in the two countries. According to a recent report by eMarketer, while more apps overall are downloaded in the US, more apps per person are downloaded and used in Southeast Asia and China (eMarketer, 2014), explaining our results of greater current app downloads. At the same time, the average retention rate for the majority of newly installed apps in China does not exceed 24% (eMarketer, 2015), possibly due to the saturation of the Chinese app market with such context-aware and multi-functional apps as WeChat, QQ, and Baidu Mobile. It is possible that having allowed these established apps access to privacy-sensitive information, Chinese users would remain loyal to the current apps, as opposed to increasing their privacy exposure and adopting or using new apps that do not offer additional functionality. In fact, Chinese retailers prefer to develop their apps within the established app platforms as opposed to creating new, stand-alone ones (Localytics, 2015). In the US, on the contrary, the app user retention has increased from 39% in 2014 to 42% in 2015, possibly reflecting the increasing stabilization of the preferred apps adoption (TechCrunch, 2016).

4. Results

Partial Least Squares (PLS), specifically SmartPLS 2.0 (Ringle, Wende, & Will, 2005), was used to test the hypotheses. Utilizing a component-based approach, PLS is designed to not only explain

Table 1
Characteristics and mobile apps usage of respondents.

		US	China	Test statistics
Gender	Male	61	60	−1.43
	Female	45	60	
Average Age		23.8	23.7	1.53
Information-sensitive mobile apps downloaded on smartphone	Fewer than 15	54	39	10.04*
	16–25	22	28	
	26–35	10	16	
	36–45	9	12	
	More than 45	11	25	
Times information-sensitive mobile apps used per day	1–5	15	27	4.62
	6–10	27	20	
	11–15	15	22	
	More than 15	49	51	
Minutes information-sensitive mobile apps used per day	1–20	14	11	20.86***
	21–60	45	31	
	61–120	35	34	
	More than 120	12	44	

All test statistics reported are Chi-Square Test of Independence statistics except average age (*t*-test).
*$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

Table 2
Factor loadings and reliability.

Items	1	2	3	4	Labels
SOCIAL1: To keep in touch with people	0.96				Socialization
SOCIAL2: To interact with people	0.65				benefit
IMPROPERACCESS: I am concerned that mobile application developers do not devote enough time and effort to preventing unauthorized access to my personal information.		0.84			Perceived privacy concern
SECONDARYUSE: I am concerned that when I give personal information to a mobile application for some reason, the application would use the information for other reasons.		0.82			
AWARENESS: It usually bothers me when I am not aware or knowledgeable about how my personal information will be used by mobile applications providers.		0.77			
COLLECT: It usually bothers me when mobile applications ask me for personal information.		0.73			
CONTROL: It usually bothers me when I do not have control or autonomy over decisions about how my personal information is collected, used, and shared by mobile applications.		0.66			
ERROR: I am concerned that mobile applications providers do not have adequate procedures to correct errors in my personal information		0.51			
LEISURE3: Because it helps me to relax.			0.88		Leisure benefit
LEISURE4: Because it is a pleasant break from my routine.			0.80		
LEISURE5: Because it is entertaining.			0.77		
LEISURE2: Because it helps me to pass time.			0.73		
LEISURE1: Because it helps me to combat boredom.			0.52		
INFO6: Because it is more convenient than accessing information from other sources				−0.76	Information
INFO 1: Because it helps me to find locations, required products and services				−0.74	benefit
INFO 3: Because it provides up-to-date information and news				−0.74	
INFO7: Because I can have immediate access to information anywhere anytime.				−0.72	
INFO2: Because it is easy to get information I need				−0.69	
INFO5: To keep abreast of the latest news and events				−0.68	
INFO4: To get information about something				−0.61	
Cronbach's Alpha	0.89	0.87	0.90	0.93	
Factor Mean	4.92	5.49	4.83	5.07	
Factor SD	1.31	1.06	1.05	1.03	
% variance explained	43.69	12.33	6.99	3.59	

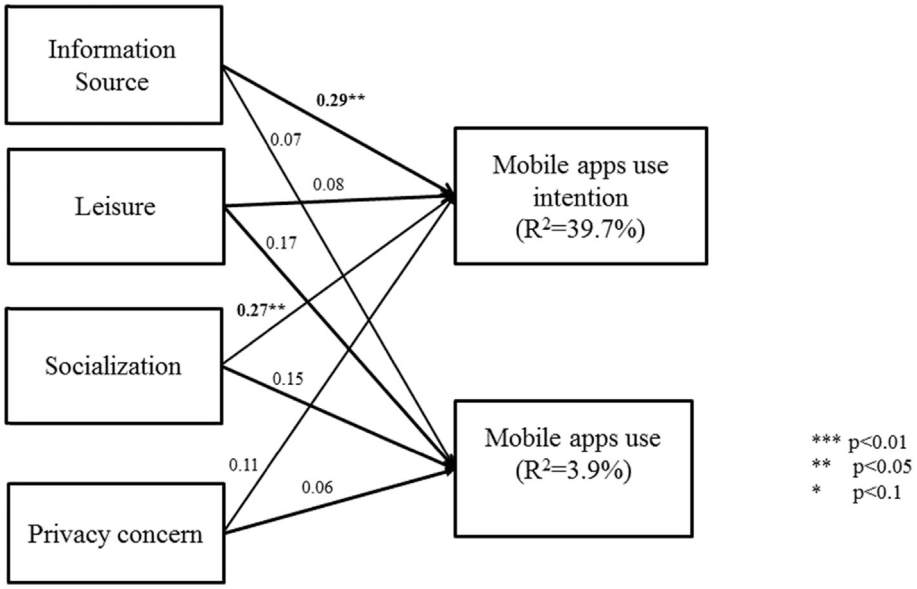
Table 3
US-China benefits, privacy and personality comparison.

Constructs	Group	Mean	Standard deviation	T test statistics
Social interaction	China	5.73	1.05	14.42***
	US	3.86	0.89	
Leisure	China	5.44	0.98	11.99***
	US	4.15	0.62	
Information	China	5.67	0.97	11.93***
Source	US	4.41	0.58	
Perceived privacy concern	China	5.61	1.09	1.80*
	US	5.36	1.01	
Intention	China	6.08	1.12	- 2.41**
	US	6.43	1.08	
Extroversion	China	4.05	1.06	−3.46***
	US	4.67	1.56	
Agreeableness	China	5.21	1.01	4.03***
	US	4.66	1.05	
Openness	China	4.85	1.09	−4.90***
	US	5.55	1.06	
Neuroticism	China	2.51	1.18	−1.78*
	US	2.22	1.27	
Conscientiousness	China	4.79	1.22	−5.11***
	US	5.60	1.15	

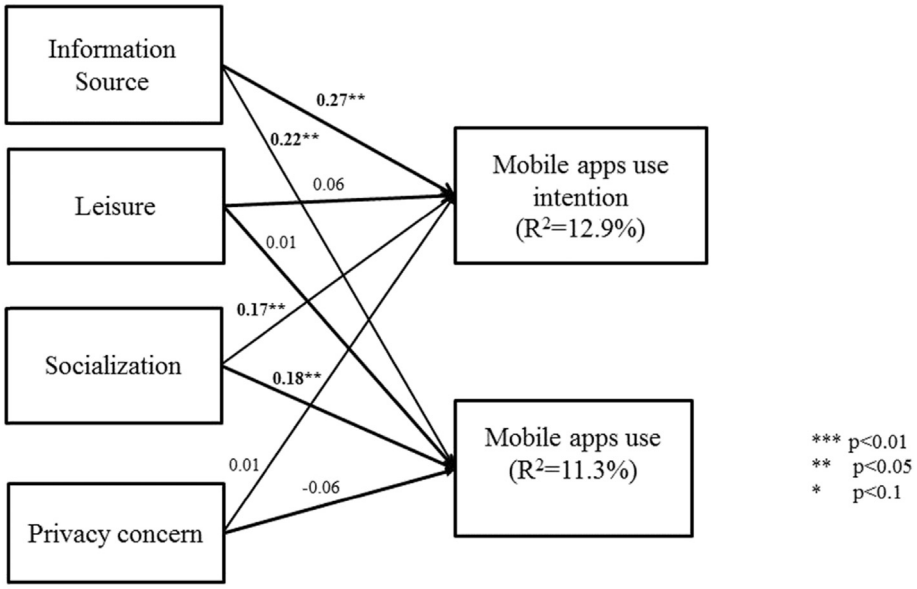
*$p < 0.10$ **$p < 0.05$ ***$p < 0.01$.

the variance (i.e. examine the significance of the relationships and variance explained, such as in linear regression), but also to simultaneously model the structural and measurement paths (Gefen, Straub, & Boudreau, 2000). PLS was chosen over covariance-based Structural Equation Modelling for two reasons. First, it is not contingent upon data having normal distributions and interval nature (Fornell & Bookstein, 1982), which makes PLS suitable for handling variables such as the number of apps downloaded and minutes spent on mobile apps per day. Second, it is not highly demanding on sample size and is appropriate for exploratory studies in the early stages of theoretical development (Fornell & Bookstein, 1982).

In order to minimize the potential for common method variance stemming from the use of perceptual measures, the survey was arranged such that the dependent variables followed the measurement of the independent variables. In addition, in order to empirically test for this potential, Harman's one-factor test was performed by entering all items in a principal component factor analysis (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). A substantial amount of common method variance is present when a



a: Factors Affecting Mobile Apps Use and Intention (China)



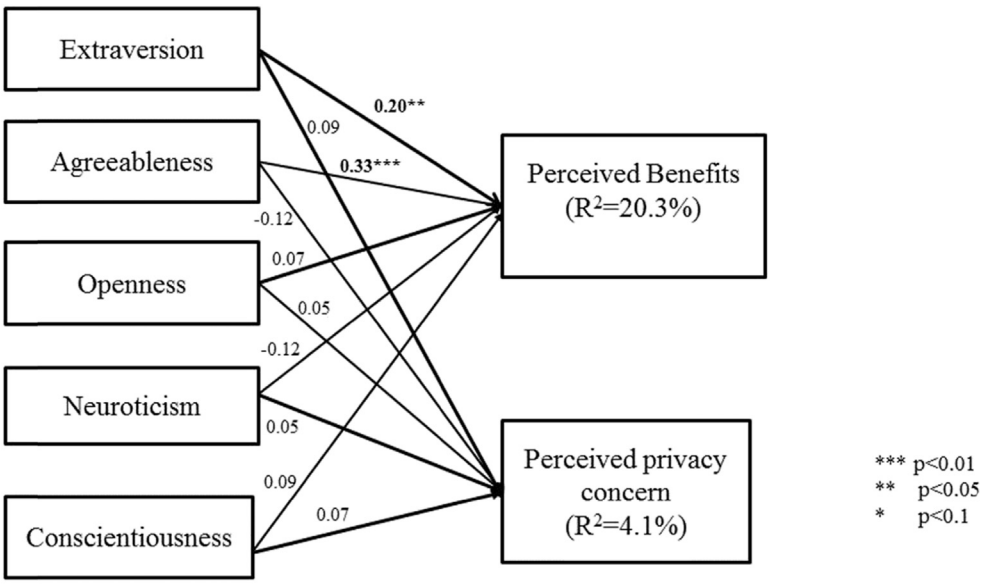
b: Factors Affecting Mobile Apps Use and Intention (US)

Fig. 2. a Factors affecting mobile apps use and intention (China). 2b: Factors affecting mobile apps use and intention (US).

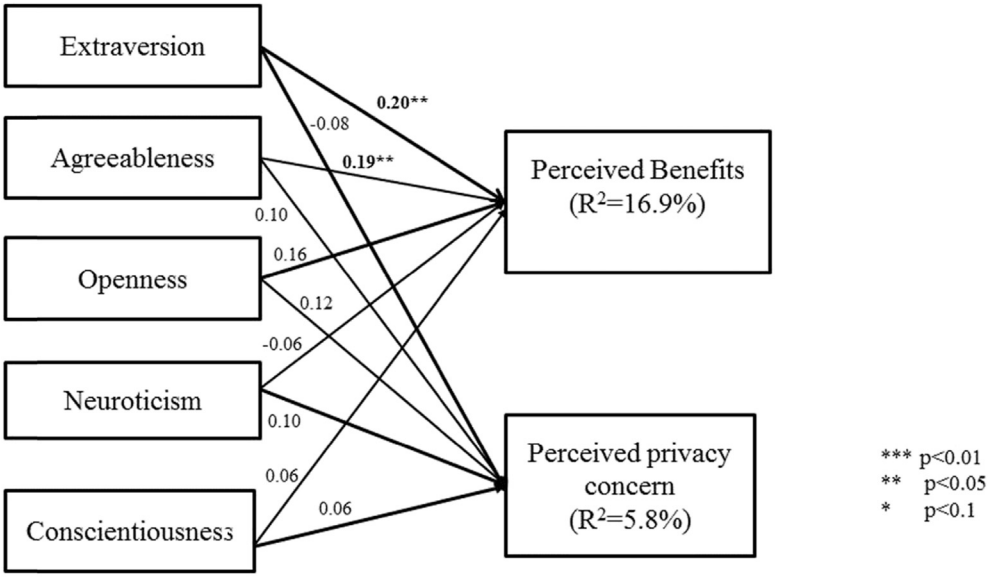
single factor emerges from the factor analysis, or one factor accounts for the majority of the covariance among measures. In our data, four factors emerged from the factor analysis. Therefore, the data do not indicate evidence of common method bias.

Hypotheses H1 and H2 were tested by examining the structural model with the perceived benefits and privacy concern as independent variables and mobile app use (measured by the total number of minutes spent on mobile apps per day and the number of apps downloaded and used often) and intention to use mobile apps in the future as the dependent variables. The PLS algorithm and the bootstrapping re-sampling methods were used to estimate the models for both countries. Fig. 2a and b shows the results for both countries. For the Chinese data, the model explains 39.7% of variance in intention and 4.1% in mobile apps use. For the US data, the model explains 12.9% of variance in intention and 11.3% in mobile apps use.

Hypothesis 1 stated that perceived benefits are positively related to current mobile apps use (H1a) and intention to use mobile apps in the future (H1b). For the Chinese sub-sample, perceived benefits were not related to current mobile apps use (H1a not supported). However, informational ($\beta = 0.29$, $p < 0.05$) and social benefits ($\beta = 0.27$, $p < 0.05$) were significantly related to the intentions to use mobile apps, partially supporting H1b. Neither H2a suggesting that privacy concern is negatively related to mobile apps use nor H1b proposing negative effect of privacy concern on future intention to use mobile apps were supported for the Chinese respondents. In the US, on the contrary, both informational ($\beta = 0.22$, $p < 0.05$) and social benefits ($\beta = 0.18$, $p < 0.05$) were



a: Personality, Perceived Benefits and Privacy Concern (China)



b: Personality, Perceived Benefits and Privacy Concern (USA)

Fig. 3. a Personality, perceived benefits and privacy concern (China). 3b: Personality, perceived benefits and privacy concern (USA).

significantly related to current mobile apps use. Additionally, informational ($\beta = 0.27$, $p < 0.05$) and social benefits ($\beta = 0.17$, $p < 0.05$) are also significantly related to mobile apps use intention. Therefore, both H1a and H1b are partially supported. Similar to the Chinese sample, H2a and H2b are not supported: privacy concern is not related to either the mobile apps use intention, or the mobile apps current use.

To test H3–H5, a composite measure was created for perceived benefits using all three dimensions to simplify the model. This composite measure of perceived benefits and the measure of perceived privacy concern were used as the dependent variables, with the Big Five personality factors used as independent variables. The PLS algorithm and the bootstrapping re-sampling methods were used to estimate the models for both countries (Fig. 3a and b). For the Chinese data, the model explains 20.3% of variance in perceived benefits and 4.1% in perceived privacy concern. For the US data, the model explains 16.9% of variance in perceived benefits and 5.8% in perceived privacy concern.

H3 predicted that all personality factors are positively related to perceived benefits of using mobile apps. Among the five personality factors, extraversion ($\beta = 0.20$, $p < 0.05$) and agreeableness ($\beta = 0.33$, $p < 0.01$) are positively related to the perceived benefits in China (H3a and H3b are supported). We also hypothesized that extraversion, agreeableness and openness are negatively related to perceived privacy concern (H4), and neuroticism and conscientiousness are positively related to perceived privacy concerns (H5). The results show that none of the personality factors are related to privacy concern (H4 and H5 are rejected). Similar to the results in

China, extraversion ($\beta = 0.20$, $p < 0.05$) and agreeableness ($\beta = 0.19$, $p < 0.05$) are positively related to perceived benefits for the US sample (supporting H3a and H3b), and none of the personality factors are correlated with privacy concerns (H4 and H5 are rejected). Table 4 shows the summary of the results.

5. Discussion and implications

This study utilized the privacy calculus theory to propose and test a research model comparing the roles of perceived benefits and perceived privacy concern in affecting adoption and use of personal-information sensitive mobile apps in two countries: the US and China. Our results show that millennial mobile app users in both countries intend to download and continually use mobile apps that require access to personal information in order to satisfy their a) informational and b) social needs. Entertainment (or leisure) does not appear to be a factor influencing adoption of private-data sensitive apps. For companies interested in obtaining customer targeting information through mobile apps this finding implies less emphasis on developing apps with entertaining content or individual play functions, potentially regardless of the cultural or national context. We also find that perceived privacy concern does not appear to play a role in the adoption or future use intentions of private-information sensitive apps in either the US or China. This finding, together with the high levels of privacy concern in both countries (US mean = 5.36 and China mean = 5.61 on the scale of 1–7), supports the privacy paradox phenomenon, whereas perceptions of concern do not seemingly affect actual behaviors. Our results appear to support earlier findings that risk perception does not have a strong enough influence on actual risk-avoiding behavior in the presence of strong positive perceptions of obtained benefits (Norberg, Horne, & Horne, 2007).

The identified differences between the Chinese and American respondents in the roles of perceived benefits in affecting actual app use vs future use intentions can be attributed to the different app diffusion dynamics. Ostensibly, the US users are currently at the stage of forming their long-term preferences and app loyalty, illustrated by the lower numbers of new app downloads (Nielsen, 2014) and increased retention rates (eMarketer, 2015; Pew Research, 2015), characterized by greater attention to the perceived app benefits. In China, the highly developed broad functionality of pre-installed dominant mobile apps (e.g. social media use for mobile payments, banking, and m-commerce) de-emphasizes the importance of concrete benefits obtained from these apps, and attaches the requirement of extra benefits only to the new, more functionally concrete apps. These differences suggest that marketers interested in initiating new in-app interactions should offer informational and social incentives to both American and Chinese customers. However, businesses should also keep in mind that once a certain threshold of app downloads and use is reached, the extent of their use can be driven not by the benefits they provide, but possibly by user habitual behaviors. If true, the latter supposition may offer an insight into app loyalty formation, an interesting topic for future research.

The results of the study also provide an interesting contribution to the research on the role of personality in technology adoption in the context of mobile apps that require access to private personal information. First, they show that certain personality traits, namely extraversion and agreeableness, increase user perceptions of benefits obtained from adoption and use of such apps, irrespective of the cultural or national environments. This finding is novel and may indicate precedence of the technological environment over cultural/national environment for demographically similar cohorts of comparable socio-economic status in segmenting technology users. However, given the historically different emphasis on such values as conformity, security, and self-direction in the two countries in our sample, the similar roles of personal extraversion and agreeableness in determining perceptions of data-sensitive app benefits deserve greater research scrutiny in the future. Managerial propositions stemming from this finding (if confirmed) may involve development of apps with customized benefits, catering to specific personality types.

Another unexpected result of the investigation is lack of significant effects of personality traits on perceptions of privacy concern in both samples. The relatively high perceived privacy concern values among both the Chinese and US respondents, and no identified significant relationships between this concern and user personality or app adoption behaviors is reflective of the privacy paradox situation noted in other digital contexts. While the apparently low relevance of privacy concerns for app user behaviors and the lack of personal or cultural differences in the degree of privacy concern among users may suggest that marketers should ignore privacy in their growing quest for acquiring customer data, more research of this construct is in order. Specifically, perceived privacy concern may be studied in connection with such behavior-limiting variables as self-efficacy, behavioral control, or subjective norm, to ascertain the perception of the user's ability to change the concerning situation. Additionally, it is possible that only an extreme level of privacy concern can be effective in influencing behavior. Finally, given the unprecedented access to private information in the digital space, it is possible that the security of private information has become a more important factor defining app users' behaviors and intentions, and therefore, needs to be studied in place of or in connection with the privacy concern.

While the use of a convenience sample limits the

Table 4
Summary of the hypotheses testing results.

	Results
H1a: Perceived benefits → mobile apps use (+)	Rejected (China)/Partially Supported (USA)
H1b: Perceived benefits → mobile apps use intention (+)	Partially Supported
H2a: Perceived privacy → mobile apps use (−)	Rejected
H2b: Perceived privacy → mobile apps use intention (−)	Rejected
H3a: Extraversion → perceived benefits (+)	Supported
H3b: Agreeableness → perceived benefits (+)	Supported
H3c: Openness → perceived benefits (+)	Rejected
H3d: Neuroticism → perceived benefits (+)	Rejected
H3e: Conscientiousness → perceived benefits (+)	Rejected
H4a: Extraversion → perceived privacy concern (−)	Rejected
H4b: Agreeableness → perceived privacy concern (−)	Rejected
H4c: Openness → perceived privacy concern (−)	Rejected
H5a: Neuroticism → perceived privacy concern (+)	Rejected
H5b: Conscientiousness → perceived privacy concern (+)	Rejected

generalizability of the results, the sampling specifics of the study (limiting respondents to the millennial cohort and focusing on smartphones as mobile app interfaces) suggests potential directions for future research. First, the role of privacy calculus mechanism and the phenomenon of privacy paradox in adopting sensitive apps can be examined among other age categories (Generation Y, Baby Boomers, etc.) that may exhibit variability in technology-related privacy concerns due to difference in life-time exposure to technology. Second, future research should consider other mobile app device categories. It is possible that there are differences in perceived benefits and privacy concerns of mobile app adoption based on the preferred device to access these apps. Specifically, the leisure/entertainment benefit may be more prominent for tablet mobile app users, due to greater accessibility of visual content (such as videos and games) on larger screens. Conversely, greater portability of smartphones may be responsible for the adoption of more functional context-aware apps (such as mobile payments, directions and price comparison) or those with social (locating friends) benefits. Additionally, wearable devices with access to such sensitive data as personal health indicators may elicit significantly higher privacy concerns. Finally, it is possible that different age groups prefer different mobile app devices. For example, ComScore reports that tablet mobile apps are mainly used by individuals older than 55 (estimated at 35 h per month), while Generation Y users average up to 90 h a month of using smartphone apps (ComScore, 2015).

6. Conclusion

The current paper contributes to the existing literature on new consumer technology adoption by applying the privacy calculus theory to propose attitudinal and personality-based factors affecting the adoption and use of mobile apps that require access to private customer data (location, contacts, photos, health indicators, bank information, etc.). The proposed model is tested using convenience samples of millennials in the US and China. While its results should be generalized with caution to the mobile app adopter population, the study offers a number of interesting findings. First, it supports the privacy paradox phenomenon, whereas relatively high levels of privacy concern among respondents in both countries do not affect their use or future intention to use mobile apps that require access to sensitive data. Second, it upholds the privacy calculus theory by identifying informational and social benefits as drivers of a wide range of mobile app adoption and use in both countries. Third, it identifies extraversion and agreeableness as significant personality traits increasing the perception of data-sensitive app benefits in both countries. Finally, it suggests that privacy concern levels are universally high, and are not determined by personal or national/cultural differences. After taking into account such limitations as relatively small sample size and cross-sectional survey-based research design, marketing practitioners and scholars can benefit from our findings. Specifically, the results suggest using personality-based targeting in global mobile app development, incorporating and explicating informational and social benefits of data-sensitive apps to current and future app users in the US, and to new app adopters in China. They also imply the need for developing habitual use of data-sensitive apps at the current stage of flattening mobile app adoption in this country.

The paper also highlights other little-researched but potentially important aspects of information-sensitive app diffusion. Among them are the need to incorporate behavior-limiting variables in future studies of privacy concern, as well as the possibility to include information security perceptions in future theoretical models of consumer technology adoption. Other areas to explore include personality and cultural variables as drivers of perceptions and attitudes in the new technology adoption studies.

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