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Cross-cultural and gender associations with anxiety about electronic data hacking



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1. Introduction

ABSTRACT

We investigated the impact of data hacking on clinical anxiety and worry. 389 American and 216 Korean college students were recruited, surveyed using the Generalized Anxiety Disorder-7 (GAD-7) questionnaire, and adapted GAD-7 specifically assessing data hacking anxiety. Using confirmatory factor analysis with measurement invariance testing, Koreans scored higher on severity of hacking anxiety items, and differently on factor loadings. Controlling for other variables such as age and prior hacking victimization, cultural group status remained a robust predictor for hacking anxiety. Hacking anxiety in both cultural groups was higher in women than men. Results are placed into the context of theory on information privacy concerns and cross-cultural differences on such concerns.

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In the modern era, people in industrialized countries have unprecedented levels of access to the internet and smartphones. National opinion polls demonstrate heavy saturation of internet access and use for most demographic groups (Perrin & Duggan, 2015), and global daily reliance on smartphones (Poushter, 2016). Such technologies are used daily for purposes such as productivity enhancement, information seeking, social interaction, diversion and relaxation, and entertainment (van Deursen, Bolle, Hegner, & Kommers, 2015). However, with this increased digital connection, people are increasingly affected by electronic data hacking and breaches (Ayyagaria, 2012; Liu, Musen, & Chou, 2015; Posey Garrison & Ncube, 2011). Furthermore, intrusive, warrantless government electronic surveillance is pervasive (Greenwald, 2014; Landau, 2013). In the present paper, we investigate what impact

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electronic data hacking has on emotional distress - specifically, anxiety and worry - and the moderating role of cultural background and gender.

1.1. Background and literature review

Concern about information privacy has been studied empirically in scientific journals. This research has focused on privacy concerns about social networking sites (Chen & Chen, 2015; Nemec Zlatolas, Welzer, Heričko, & Hölbl, 2015; Osatuyi, 2015) and smartphones (Kang & Shin, 2016; Mamonov & Benbunan-Fich, 2015). Additional concerns have been investigated about keystroke loggers, exercise health data and video surveillance (Oulasvirta, Suomalainen, Hamari, Lampinen, & Karvonen, 2014), as well as geo-location data (Mamonov & Benbunan-Fich, 2015). Most of this research has been conducted by researchers in fields such as communications, journalism, business management, and information technology/computer science. However, our focus in the present paper is to study information privacy concern from a psychological perspective, by examining associated emotional distress.

"Information privacy" is often conceptualized in the research

literature from a values-based perspective, with the assumption and rationale that it is within an individual's rights to keep their electronic data safe. However, another perspective adds nuance by suggesting that information privacy is a commodity that may be bought, sold or exchanged (Pavlou, 2011), such as giving up some privacy when performing an internet search in exchange for free searching provided by the search engine. In more recent years, the information privacy construct has added an element of autonomy, now conceptualized as involving control by the individual as to where his/her private information is used (Smith, Dinev, & Xu, 2011). Additional nuance in this construct involves the issue of context, whereby the definition and experience of privacy may differ greatly across cultures, settings and situation (Acquisti, Brandimarte, & Lowenstein, 2015).

There are numerous threats in modern times to digital information privacy. The impact of such threats are fear reaching, including compromises to economic wealth, individual civil liberties, as well as discrimination and censorship (Acquisti et al., 2015). The targets of information privacy threats can include consumer financial data (Bohannon, 2015), private location data (You, 2015), cloud-based data (Chou, 2013), personal data mined by government entities and corporations (Bettini & Riboni, 2015), and internet of things (IoT) data from home automation devices (S. Li, Tryfonas, & Li, 2016).

"Information privacy concern" is typically defined in the literature as the perception of losing control over one's personal information, with possible use by third parties (Bélanger & Crossler, 2011; Pavlou, 2011). Other conceptualizations are similar, but add features including improper data access and errors (Acquisti et al., 2015).

Three previous papers in particular have examined clinically relevant anxiety about electronic privacy. Chai, Bagchi-Sen, Morrell, Rao, and Upadhyaya (2009) examined anxiety about information privacy among 285 American adolescents. The authors found that being victim of a hacking incident significantly predicted anxiety about possible future data hacking. Similar results were obtained in a more recent study of 305 American adults from a community sample (Elhai, Levine, & Hall, in press). Also recently, Elhai and Hall (2016) investigated anxiety from electronic data hacking in a community sample of 304 American adults. The authors found that anxiety about hacking was somewhat higher than, and distinct from, baseline anxiety.

1.2. Theory

Prospect Theory (PT) is a relevant theory for contextualizing this research area, focusing on how individuals arrive at decisions when risk is involved (Kahneman & Tversky, 1979). PT assumes that in estimating possible gains or losses, people use heuristics to arrive at such decisions. And such heuristics can involve distortions in probability estimation based on an individual's risk-averse or riskseeking behavior (Tversky & Kahneman, 1992). PT has been used in conceptualizing perceptions of online privacy (e.g., Baek, 2014; Liang & Xue, 2009). Specifically, individuals may inaccurately estimate the level of risk associated with their information privacy, leading to a heightened (or minimized) concern or anxiety about electronic data breaches. Having an unrealistically high level of anxiety regarding information privacy can be emotionally distressing (Elhai & Hall, 2016), while an unrealistically low level of concern can lead to inadequate privacy protection behavior (Chai et al., 2009; Elhai et al., in press).

We should also acknowledge that other existing theories can explain concern about information privacy, and associated privacy protection behavior. These theories include Privacy Calculus Theory (PCT), and Protection Motivation Theory (PMT). PCT (Culnan & Armstorng, 1999) assumes that individuals perform a risk-benefit analysis when considering whether to disclose private information. Although PCT has been widely studied in the information privacy area, it has been criticized for assuming that individuals typically make rational decisions about privacy protection (Y. Li, 2012). On the other hand, PMT (Rogers, 1983) assumes that social-cognitive variables influence privacy behavior. However, PMT has been less widely studied with regard to information privacy (Y. Li, 2012).

1.3. Aims

Some research has found cultural differences in information privacy concern (Cullen, 2009; Lowry, Everard, & Cao, 2011). Eastern cultures having a greater emphasis on information privacy than Western cultures (Lin et al., 2012; Lowry et al., 2011). Additionally, men and women differ in terms of information privacy concern and practices (Hoy & Milne, 2010; Lewis, Kaufman, & Christakis, 2008; Litt, 2013) – especially outside their close peer group (Lin et al., 2012). Women use a more diverse set of secure technology practices (Litt, 2013). And women are more likely to experience anxiety, and anxiety disorders, than men (reviewed in McLean & Anderson, 2009).

In the present study, we extend this line of inquiry regarding clinical anxiety from electronic data hacking. We administered an established measure of anxiety symptoms, and re-administered it by inquiring about anxiety specifically from data hacking. We compared a confirmatory factor analytic (CFA) model of clinical anxiety about data hacking to a factor model of general anxiety among college students. We also explored correlates of anxiety about hacking, using measurement invariance testing. Specifically, we tested the impact of culture, by testing two subgroups of college students – one from the U.S., and the other from South Korea.

1.4. Hypotheses

We posed the following hypotheses.

1). We hypothesized that anxiety about data hacking would have an equivalent symptom structure to general anxiety, in both the Korean and U.S. cultures, based on non-significant group differences in factor loadings.

Research finds similarities in the latent structure of different types of anxiety or stressors (Armour, Műllerová, & Elhai, 2016; Elhai et al., 2009). Thus we hypothesized to find equivalence between the latent structure of data hacking anxiety and general anxiety.

2). We hypothesized that for both the Korean and U.S. samples, data hacking anxiety would be rated as less severe than general anxiety, based on smaller observed variable intercept values for hacking anxiety.

Elhai and Hall (2016) found significant levels of anxiety about data hacking. However, the authors used a single-item measure of anxiety, querying different types of data breaches. Using a psychometrically-sound measure of clinical anxiety in the present study, we hypothesized that general anxiety would be higher than anxiety about data hacking. After all, notwithstanding the importance of anxiety about data hacking, anxious people worry about additional, substantial content areas other than data hacking (Lindesay et al., 2006).

3). We hypothesized that women would evidence greater levels of hacking anxiety than men, based on higher levels of hacking anxiety intercepts.

Women and men generally do not differ on the symptom structure of anxiety, based on factor loadings (Carragher et al., 2016; Löwe et al., 2008). However, the severity of their anxiety about data hacking should be greater than that of men's. First, women experience more anxiety than men do (McLean & Anderson, 2009). Second, women place a greater focus on information privacy than men, but not necessarily a different meaning or interpretation (Hoy & Milne, 2010; Lewis et al., 2008). For these reasons, we hypothesized greater levels of hacking anxiety among women.

4). We hypothesized that the factor structure of hacking anxiety would be different between Koreans and Americans, judged by significant between-culture differences in hacking anxiety factor loadings.

Information privacy means something different to Asians and Americans, given differences across cultures in such variables as individuality, collectivism, masculinity and trust (Lin et al., 2012; Lowry et al., 2011). Research has found, for example, that a lower emphasis on individuality and masculinity among Asian cultures drives greater privacy concerns and desires for digital awareness (Lowry et al., 2011). Thus we hypothesized finding factor loadings to vary across cultures. We also expected to find greater levels of hacking anxiety in Koreans because of more privacy concern among the Asian culture (Lin et al., 2012; Lowry et al., 2011).

5). We hypothesized that both the structure and severity of general anxiety would not differ between Koreans and Americans, based on non-significant differences between cultures on general anxiety factor loadings and item intercepts, respectively.

This research question has been studied previously. Anxiety rates and meaning are roughly similar across cultures, albeit with slightly higher prevalence rates among Americans (Lewis-Fernandez et al., 2010). Thus we hypothesized to also find cross-cultural similarities in general anxiety.

2. Method

2.1. Procedure

In spring and fall 2015, we recruited students from two universities of comparable size (about 20,000 students) – one in a metropolitan Midwestern U.S. city, and the other in a large city in South Korea. Procedures were similar at both universities. Students enrolled in psychology or business courses were invited through their instructors or subject research pool to participate in a 15–20 min web survey (in English) for research or extra credit. The study was described as being about "use of mobile devices and web services, and your emotions." We obtained consent through an online consent statement.

2.2. Participants

We obtained valid data from 389 American students and 216 Korean students, for a maximum sample size of 605 participants. The minimum sample size for an analysis was 600 participants. Women made up 286 respondents (73.7%) from the American sample, and 142 respondents (66.0%) from the Korean sample. Most Americans were Caucasian (n = 301, 77.5%), African American (n = 65, 16.7%), or Hispanic (n = 22, 5.7%) (response options were not mutually exclusive); the vast majority of Korean students was endorsed by most Americans (n = 340, 87.6%) and Koreans (n = 189, 87.1%). Average participant age for Americans was 19.68 years

(SD = 3.84), and for Koreans was 25.04 (SD = 5.13). Using chi-square tests for categorical variables and analyses of variance (ANOVA) for continuous variables, except for an obvious between-groups difference in race/ethnicity, the only statistically significant demographic variable between universities was age, F(1,603) = 202.96, p < 0.001, $\eta^2 = 0.25$.

2.3. Measures

All surveys were administered in English. We first inquired about demographics, including such variables as age, ethnicity and race, and relationship status.

Next we administered the Generalized Anxiety Disorder-7 questionnaire (GAD-7) (Spitzer, Kroenke, Williams, & the Patient Health Questionnaire Primary Care Study Group, 1999). The GAD-7 is a 7-item measure of generalized anxiety and worry, with items mapping onto DSM-5 symptom criteria for GAD experienced over the previous two weeks. The GAD-7 has psychometric support (Kroenke, Spitzer, Williams, & Lowe, 2010), and a unidimensional factor structure (Dear et al., 2011; Ryan, Bailey, Fearon, & King, 2013; Spitzer, Kroenke, Williams, & Löwe, 2006). It uses a fouroption Likert response format of symptom frequency. However, we adapted the response format by using a symptom intensity format instead, in order to later inquire about imaginal anxiety/ worry in thinking about data breaches (which does not fit with symptom frequency queries). We used a five-item response format of intensity used elsewhere (Weathers et al., 2013), with options of 0 ("not at all"), 1 ("a little bit"), 2 ("moderately"), 3 ("quite a bit"), and 4 ("extremely"). Coefficient alpha in our sample was 0.93 for Americans, and 0.89 for Koreans.

Next we inquired about technology device and service use by asking "How often do you actively use the following...?" regarding "electronic devices" and "services." We asked about devices including "smartphone," "laptop/notebook computer," "desktop computer," "tablet that does more than an e-book reader (e.g., iPad, Galaxy Tab)," "e-book reader-only tablet (e.g., original black-andwhite Kindle)," and "basic cell phone (that doesn't have advanced features like email and apps)." We queried internet and communication services including "internet web browser," "voice phone calls (with a cell or smartphone or landline)," "video calls (e.g., FaceTime, Skype, etc.)," and "social media networks (e.g., Facebook, Twitter, Instagram, Flickr, LinkedIn, etc.)." Response options were phrased in the amount of daily use, including 1 ("never"), 2 ("not regularly"), 3 ("less than an hour per day"), 4 ("1–2 h per day"), 5 ("3–4 h per day"), and 6 ("5 or more hours per day").

We subsequently provided information about recent highprofile electronic data hacking incidents featured in the news media, such as hacked iCloud nude photos, stolen eBay login credentials, and Target's financial data breach (NBC News, 2014; Zetter, 2014). We also described government electronic surveillance revealed in the Edward Snowden revelations, including bulk collection of mobile phone data and interception of Yahoo and Google data centers (Greenwald, 2014). After providing this information, we re-administered the GAD-7 (using adaptations indicated above), instructing participants "When thinking about these types of electronic data breaches happening to you, how much are you bothered by the following problems?" Coefficient alpha was 0.90 for Americans, and 0.95 for Koreans.

Finally, we asked about previous exposure to various types of data breaches, using "yes/no" items from Elhai and Hall (2016). Relevant to the present paper, we asked "Have you ever had any of the following incidents happen to you?": "information/data accessed from your computer, phone, etc., by someone not authorized to do so," "your email compromised, hacked or broken into," "your social media account compromised, hacked, or broken into,"

and "your bank account was broken into/hacked using your credentials by someone unauthorized to do so."

2.4. Analysis

We first used maximum likelihood estimation (MLE) procedures to estimate missing item-level values for general anxiety and hacking anxiety. We summed item-level values to form total general anxiety and hacking anxiety scores; both variables were normally distributed. We used mixed design, between-within subjects ANOVAs to examine the effects of a) student group (Americans vs. Koreans), b) anxiety testing instructions (general anxiety vs. hacking anxiety), and c) the student group X anxiety testing instructions interaction; the dependent variable was self-reported anxiety scores.

We tested a one-factor model of anxiety and worry for the GAD-7, using Mplus version 7 software. We also tested a one-factor GAD-7 hacking anxiety model. We treated items as continuously-scaled. We used MLE with robust standard errors, generating the Yuan-Bentler (Y-B) scaled chi-square statistic (Yuan & Bentler, 2000). Excellent (or good) fit was judged using the comparative fit index (CFI) ≥ 0.95 (0.90), Tucker-Lewis Index (TLI) ≥ 0.95 (0.90), root mean square error of approximation (RMSEA) ≤ 0.06 (0.08), and standardized root mean square residual (SRMR) ≤ 0.08 (0.10) (Hu & Bentler, 1998).

We used measurement invariance procedures within each university's sample separately to compare the latent structure of general anxiety with hacking anxiety (testing Hypotheses 1 and Hypotheses 2). Using established procedures (Meredith & Teresi, 2006; Millsap, 2011) we progressively tested for differences in factor loadings, then observed variable intercepts. We estimated residual error covariances between the two counterpart item versions of the same symptom (Cole, Ciesla, & Steiger, 2007). We used a correction factor for chi-square difference comparisons (Muthén & Muthén, 2006).

We tested measurement invariance using multi-group CFA to determine the effect of gender on hacking anxiety (Hypothesis 3), and general anxiety. And we used this approach to compare American with Korean students on anxiety about hacking (Hypothesis 4), as well as on general anxiety (Hypothesis 5). Finally, because age and prior hacking victimization were significantly different between universities, we also conducted multiple indicators multiple causes (MIMIC) modeling, to assess the effect of cultural group on hacking anxiety and general anxiety, after statistically adjusting for age and prior hacking victimization.

3. Results

3.1. Descriptive statistics

Regarding technology usage of the samples, Americans reported using their smartphones more than Koreans, with highest levels (5+ hours per day) endorsed by 222 Americans (57.8%) and 95 Koreans (44.0%), χ^2 (5, n = 600) = 16.67, p = 0.005, phi = 0.17. Internet web browser use at the highest levels (5+ hours per day) was reported by 91 Americans (23.6%) and 37 Koreans (17.2%), which was equivalent across the groups, χ^2 (5, n = 600) = 7.84, p = 0.17, phi = 0.11.

We explored previous hacking victimization based on whether the respondent endorsed having had their electronic data accessed without authorization, or had their email, social media or bank account compromised or hacked. 163 Americans (42.3%) and 112 Koreans (52.1%) endorsed prior hacking victimization, $\chi^2(1, n = 600) = 5.29$, p = 0.02, phi = 0.09.

3.2. Total anxiety and hacking anxiety scores

When examining the general and hacking anxiety ratings, we found a significant main effect for student group (Americans vs. Koreans), F(1, 604) = 43.28, p < 0.001, $\eta^2 = 0.07$, a main effect of anxiety testing administration (general vs. hacking anxiety), F(1, 604) = 37.48, p < 0.001, $\eta^2 = 0.06$, and an interaction, F(1, 604) = 118.42, p < 0.001, $\eta^2 = 0.16$. When statistically adjusting for age as a covariate, a similar pattern of findings emerged, with a main effect for student group, F(1, 602) = 46.64, p < 0.001, $\eta^2 = 0.07$, a main effect of anxiety testing administration, F(1, 602) = 11.06, p = 0.001, $\eta^2 = 0.02$, and a significant interaction, F(1, 602) = 69.90, p < 0.001, $\eta^2 = 0.10$.

To further probe these effects, we report univariate comparisons, split up individually by group and type of anxiety assessed. American students had significantly lower total scores for anxiety about hacking compared with Korean students (see Table 1 for means and standard deviations). Americans and Koreans were not significantly different on general anxiety (Table 1). After statistically controlling for age, anxiety about hacking remained different between groups, F(1, 602) = 70.41, p < 0.001, $\eta^2 = 0.19$; and general anxiety emerged as different across groups, F(1, 604) = 5.04, p = 0.007, $\eta^2 = 0.02$.

Within a particular group, Americans' general anxiety scores were higher than their hacking anxiety scores (descriptive statistics are in Table 1). However, the reverse was true for Koreans.

3.3. Latent models of anxiety: American students

In this section, we focus on results among the American students. A one-factor model of hacking anxiety fit well, Y-B $\chi^2(14, n = 389) = 66.89, p < 0.001$, CFI = 0.94, TLI = 0.92, RMSEA = 0.10 (90% CI: 0.08–0.12), SRMR = 0.04. A one-factor model of general anxiety also fit well, Y-B $\chi^2(14, n = 389) = 65.95, p < 0.001$, CFI = 0.96, TLI = 0.93, RMSEA = 0.10 (90% CI: 0.08–0.12), SRMR = 0.04.

Constraining factor loadings to be equal between hacking anxiety and their counterpart general anxiety ratings did not significantly reduce fit (testing Hypothesis 1). Further constraining intercepts resulted in worse model fit (general anxiety intercepts were significantly higher) (See Table 2).

For hacking anxiety, constraining factor loadings between men and women students did not worsen fit (Hypothesis 3; see Table 2). Further constraining intercepts worsened fit (women had higher intercepts). A similar pattern emerged for general anxiety.

3.4. Latent models of anxiety: Korean students

In this section, we focus on results among the Korean students. A one-factor model of hacking anxiety fit well, Y-B $\chi^2(14, n = 216) = 55.30, p < 0.001$, CFI = 0.95, TLI = 0.93, RMSEA = 0.12 (90% CI: 0.09–0.15), SRMR = 0.03. A one-factor model of general anxiety also fit well, Y-B $\chi^2(14, n = 216) = 34.85, p < 0.001$, CFI = 0.96, TLI = 0.94, RMSEA = 0.08 (90% CI: 0.05–0.12), SRMR = 0.04.

Constraining factor loadings to be equal between hacking anxiety and counterpart general anxiety ratings significantly reduced fit (Hypothesis 1; see Table 2) (hacking anxiety loadings were significantly higher). Further constraining intercepts resulted in worse model fit, with significantly higher hacking anxiety intercepts.

For hacking anxiety, constraining factor loadings between men and women worsened fit (Hypothesis 3; see Table 2), without a discernable pattern of gender differences. Further constraining intercepts worsened fit, with mixed gender differences. For general

Table 1

Total scores for hacking anxiety a	and general anxiety	(means and standard	deviations), b	v culture (Una	liusted).

Group	Hacking anxiety M (SD)	General anxiety M (SD)	Test statistic comparing hacking vs. General anxiety within a culture
Americans Koreans Test Statistic Comparing Americans and Koreans	$\begin{array}{l} 4.85 \ (5.61) \\ 11.00 \ (6.91) \\ f(1, 604) = 141.33, \ p < 0.001, \\ \eta^2 = 0.19 \end{array}$	$\begin{array}{l} 10.02 \; (6.64) \\ 9.55 \; (5.81) \\ F(1, \; 604) = \; 0.76, \; p > 0.05, \\ \eta^2 = \; 0.001 \end{array}$	$F(1, 388) = 208.27, p < 0.001, \eta^2 = 0.35$ $F(1, 216) = 8.36, p < 0.001, \eta^2 = 0.04.$

Table 2

Model constraints.

Constraint added	Type of comparison	Y-B Chi-Square difference test results: Americans	Y-B Chi-Square difference test results: Koreans	
Factor loadings Intercepts	Hacking anxiety vs. General anxiety Hacking Anxiety vs. General Anxiety	$\begin{array}{l} \chi^2_{diff}(7,n=389)=5.43,p=0.61\\ \chi^2_{diff}(7,n=389)=807.07,p<0.001 \end{array}$	$\begin{array}{l} \chi^2_{diff}(7,n=216)=111.05,p<0.001\\ \chi^2_{diff}(7,n=216)=54.75,p<0.001 \end{array}$	
Factor Loadings Intercepts	Hacking Anxiety: Men vs. Women Hacking Anxiety Men vs. Women	$\begin{array}{l} \chi^2_{diff}(6,n=388)=8.64,p=0.20\\ \chi^2_{diff}(6,n=388)=32.54,p<0.001 \end{array}$	$\begin{array}{l} \chi^2_{diff}(6,n=214)=29.65,p<0.001\\ \chi^2_{diff}(6,n=214)=41.59,p<0.001 \end{array}$	
Factor Loadings Intercepts	General Anxiety: Men vs. Women General Anxiety Men vs. Women	$\begin{array}{l} \chi^2_{diff}(6,n=388)=4.97,p=0.55\\ \chi^2_{diff}(6,n=388)=15.06,p=0.02 \end{array}$	$\begin{array}{l} \chi^2_{diff}(6,n=214)=8.84,p=0.18\\ \chi^2_{diff}(6,n=214)=17.56,p=0.007 \end{array}$	
Americans and Koreans: Y-B Chi-Square difference test results between groups				
Factor Loadings Intercepts	Hacking Anxiety: Americans vs. Koreans Hacking Anxiety: Americans vs. Koreans	$\begin{array}{l} \chi^2_{diff}(6,n=605)=23.28,p<0.001\\ \chi^2_{diff}(6,n=605)=14.43,p=0.03 \end{array}$		
Factor Loadings Intercepts	General Anxiety: Americans vs. Koreans General Anxiety: Americans vs. Koreans	$\chi^2_{diff}(6,n=605)=8.30,p=0.22$ $\chi^2_{diff}(6,n=605)=51.08,p<0.001$		

anxiety, factor loading constraints did not worsen fit. Constraining intercepts resulted in worsened fit, with higher intercepts among women.

3.5. Latent models of anxiety: American/Korean student differences

For illustrative purposes, Table 3 displays this hacking anxiety model, displaying factor loadings separately for Americans and Koreans. For hacking anxiety, constraining factor loadings between American and Korean students worsened fit (Hypothesis 4; see Table 2), with Koreans having higher loadings; constraining intercepts worsened fit (Koreans had higher intercepts). For general anxiety, factor loading constraints did not worsen fit; constraining intercepts resulted in worsened fit Americans had higher intercepts; Hypothesis 5).

We recomputed these models by conducting them separately by gender, in order to assess if the cross-cultural difference in factor loadings was present in male-only comparisons and/or female-only comparisons. Male-only analyses revealed equivalent factor loadings across cultures for hacking anxiety and general anxiety. Women-only analyses revealed significant differences in factor loadings across cultures for hacking anxiety, but not for general anxiety.

Finally, because age and prior hacking victimization were significantly different between groups, we conducted MIMIC models to test the effect of culture on both hacking and general anxiety, while controlling for age and victimization. In predicting the hacking anxiety factor, the effect of culture was most prominent, $\beta = 0.45$, SE = 0.04, p < 0.001 (with a positive association for Koreans), while hacking victimization was also significant, $\beta = 0.12$, SE = 0.04, p = 0.001; age was not significant, $\beta = -0.03$, SE = 0.04, p = 0.48. In predicting general anxiety, the effect of culture was not significant, $\beta = 0.02$, SE = 0.05, p = 0.61; hacking victimization, $\beta = 0.14$, SE = 0.04, p = 0.001, and age, $\beta = -0.16$, SE = 0.04, p < 0.001, were significant and with equivalent path coefficients.

4. Discussion

In the present paper, we examined cultural and gender associations with anxiety about electronic data hacking. Our results tell an interesting story about differences between American and Korean participants, as well as between men and women, about anxiety about electronic privacy breaches.

American and Korean students obtained equivalent scores on general anxiety in the present study, based on observed summed scores. However, using latent variable modeling, Americans scored higher than Koreans on general anxiety. This is in line with Hypothesis 5 and is supported by previous studies showing that the prevalence of generalized anxiety is similar but slightly higher in American than Asian countries (reviewed in Lewis-Fernandez et al., 2010). Regardless of differences in severity of general anxiety, factor loading constraints did not worsen fit, and thus the meaning of generalized anxiety was the same across these two cultures, also supporting Hypothesis 5.

Table 3

Hacking anxiety model: Standardized factor loadings.

GAD-7 item	Standardized factor loadings: Americans	Standardized factor loadings: Koreans
Feeling nervous, anxious or on edge	0.72	0.75
Not being able to stop or control worrying	0.84	0.90
Worrying too much about different things	0.91	0.91
Trouble relaxing	0.86	0.86
Being so restless that it is hard to sit still	0.80	0.85
Becoming easily annoyed or irritable	0.79	0.85
Feeling afraid as if something awful might happen	0.78	0.80

A different pattern emerged between Americans and Koreans regarding anxiety about data hacking. Consistent with Hypothesis 4, Koreans scored significantly higher on item intercepts, indicating greater reported hacking anxiety severity for this group. This finding is consistent with research demonstrating that Eastern cultures place a greater emphasis on information privacy (Krasnova, Veltri, & Günther, 2012: Lin et al., 2012: Lowry et al., 2011). Framed in terms of Prospect Theory (Tversky & Kahneman, 1992), Eastern cultures may have a general heuristic toward more stringent information privacy. Alternatively, it is possible that in learning about record levels of hacking incidents in the U.S. recently (Ayyagaria, 2012; Liu et al., 2015; Posey Garrison & Ncube, 2011), Americans have become desensitized to privacy breaches, resulting in lower levels of hacking anxiety. In fact, repeated exposure or desensitization to feared stimuli is the prominent mechanism for anxiety reduction (Olatunji, Cisler, & Deacon, 2010). Koreans and Americans also scored differently on hacking anxiety factor loadings. Thus, while general anxiety is interpreted to be the same construct between these two cultures, hacking anxiety appears to represent something different between groups. Perhaps because of information privacy's greater value among Asians, the threat to one's information privacy may generate not only greater anxiety but may be associated with more perceived distressing implications about the consequence of such breaches.

We cannot ignore the effects of age and prior hacking victimization between the two university samples used in this study. After all, age has demonstrated an effect on information privacy concern (Bergström, 2015; Taddicken, 2014), as has hacking victimization (Chai et al., 2009). However, when we isolated the unique contribution of these variables on hacking anxiety, we discovered that the between-groups culture variable was really the driving predictor of hacking anxiety. Interestingly, culture did not play a prominent role in general anxiety after adjusting for these variables; however, this is not a surprising finding, given our discussion above regarding the similar rates of generalized anxiety across American and Asian cultures.

Another important finding was that hacking anxiety was not only higher in Koreans than in Americans; hacking anxiety was higher than general anxiety in Koreans. And hacking anxiety had a different construct meaning among Koreans than general anxiety did. In fact, every standardized factor loading for this group was higher for hacking than general anxiety, with an average difference of 0.46. For example, standardized loadings for hacking anxiety vs. generalized anxiety were 0.74 vs. 0.37 for nervousness, 0.89 vs. 0.38 for worrying too much, and 0.84 vs. 0.39 for irritability. This again could be explained by more emphasis (or heuristic in PT) toward information privacy among Eastern cultures (Krasnova et al., 2012; Lin et al., 2012; Lowry et al., 2011).

We also found gender differences in the present study. Consistent with Hypothesis 3, hacking anxiety was higher among American women than men, consistent with research finding greater information privacy concern for women (Hoy & Milne, 2010; Lewis et al., 2008). And general anxiety was significantly higher among American women than men, consistent with prior research (reviewed in McLean & Anderson, 2009). Based on factor loading constraints, the meaning of these constructs was similar between American men and women.

However, among Koreans, men and women not only scored differently in hacking anxiety severity, but the meaning of this construct was not equivalent. Eastern cultures are noted to place special emphasis on information privacy, as compared to Western countries (Krasnova et al., 2012; Lin et al., 2012; Lowry et al., 2011). And women are demonstrated to value information privacy more so than men (Hoy & Milne, 2010; Lewis et al., 2008; Lin et al., 2012). So perhaps for Asian women in particular, sensitivity to hacking can

be especially high enough to take on a somewhat different meaning. However, we note that while the difference in standardized factor loadings between Korean women and men was statistically significant, the magnitude of these differences was small, with the largest difference in factor loadings observed for "trouble relaxing" (0.91 vs. 0.80).

We acknowledge limitations with the present study. First, we relied on college students, which may not be generalizable to the general population. Second, American and Koreans groups were different in age and prior hacking victimization, although we statistically controlled for these variables. Third, we only used a Korean sample to compare with Americans on hacking anxiety; future studies should explore possible differences between Americans and other cultures as well. Nonetheless, the present study's innovative focus on hacking victimization, especially tested between cultures, and between men and women, adds to the literature on the impact that computer technology may have on emotional distress.

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