

Using the Extended Theory of Planned Behavior to Predict Privacy-Protection Behavioral Intentions in the Big Data Era: The Role of Privacy Concern

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ABSTRACT. This research extends the theory of planned behavior to explore how privacy concerns influence privacy-protection behavioral intentions via attitudes, subjective norms, and perceived behavioral control. Using snowball sampling, 637 participants were recruited in China to complete this online survey. After eliminating the invalid questionnaire, this study received valid samples of 599 respondents. The finding demonstrated that privacy concerns were positively associated with individuals' attitudes, subjective norms, and perceived behavioral control. And these factors also were found positively influence privacy-protection behavioral intentions. Theoretical and practical contributions are discussed as well.

1 Introduction

With the development of science and technology, the amount of data generated and captured in modern society has continued to increase rapidly, and the number of statistics has increased by the PB (1024TB) level, which has entered the era of big data. The concept of big data first appeared in Lenny's Gartner report in 2001 [11], where the term "big data" was defined as large and complex data set that computing facilities were unable to handle at that time [16]. The current big-data environment, especially regarding data mining and machine learning techniques, involve serious threats to privacy [16]. As a result, privacy concerns have attracted scholarly attention. Facebook revealed that "almost 50 million" of its users had their confidential information exposed by a security flaw in September 2018 [7]. Public polls have demonstrated evidence of heightened problems related to privacy leakage online users in the big data era as it has become easier to locate an individual's information [3]. Moreover, data leakage incidents continues to occur, exacerbating privacy concerns [3]. In addition, online service providers may leak users' personal, private data to others without notifying users or obtaining their authorization for providers' interests. Thus, protecting individual's privacy and confidential information has become extraordinarily challenging in the big data era.

Privacy-protection behaviors (PPBs) may help users minimize locating and collecting of individual's information by preventing them from giving truthful and accurate individual's information online. Therefore, this

study seeks to explore the factors that predict that an individual will practice privacy-protection behaviors.

The theory of planned behavior (TPB) is one of the most widely used theories to examine behavioral determinants. It assumes that individuals' behaviors are influenced by their attitudes, subjective norms, and perceived behavioral control [2]. A large number of researches have proved these factors play an important role in privacy-protection behavioral intentions [10]. Additionally, previous studies also have extended the TPB by taking privacy concern as an antecedent. Some scholars have noted that privacy concerns could also affect individuals' perceptions of practicing privacy-protection behaviors and even directly predict privacy-protection behavioral intentions. For example, Ho found that adolescents' privacy concerns are important for influencing their future PPBs on SNSs [10]. Moreover, Heirman found that privacy concerns are significant predictors of attitudes toward privacy-protection behaviors, which can be significantly affected by privacy-protection behavioral intentions (PPBIs) [9]. Hence, this study also seeks to explore the direct and indirect effects of privacy concerns on shaping individuals' privacy-protection behavioral intentions.

This study's objective is twofold. We aim to determine (1) whether individuals' attitudes, subjective norms, and perceived behavioral control affect privacy-protection behavioral intentions and (2) whether privacy concerns directly and indirectly affect individuals' privacy-protection behavioral intentions through attitudes, subjective norms, and perceived behavioral control.

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Additional detailed theoretical and practical implications will be provided in a later discussion.

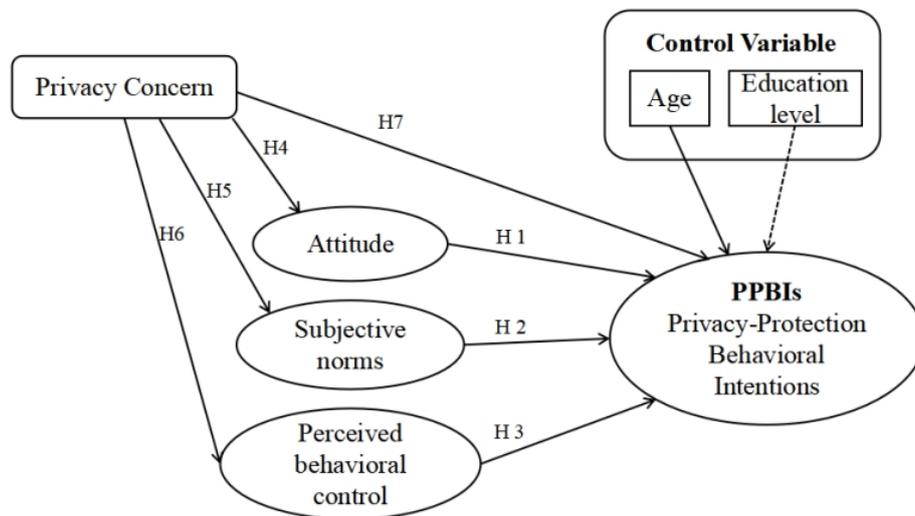


Fig. 1. Conceptual model (self-organized).

2 Literature Review and Research Hypotheses

2.1 Privacy-Protection Behavioral Intentions

Previous literature has documented the link between privacy concerns and privacy-protection behaviors, which has found that people protect online privacy through different ways [15]. Privacy-protection behaviors are defined as “specific computer-based behaviors that consumers take to protect their information safe” [12]. Specifically, individual’s privacy-protection behaviors can reduce the collection, use, and share of individual’s information to protect online privacy. For instance, individuals can protect online privacy information by restricting their shared information and taking privacy-protection behaviors [6]. Privacy-protection behaviors discussed in this study include providing incomplete individual’s information, avoiding providing truthful and accurate individual’s information, and refusing to provide actual individual’s information online. In this research, we focus on the direct and indirect factors that affect PPBIs.

2.2 Theoretical Framework: The theory of planned behavior

Adopting the theory of planned behavior, this study adopts the theory-driven approach to explain the potential factors that might be related to privacy-protection behavioral intentions (PPBIs) online. The TPB assumes that personal intentions are the closest antecedent of his or her actual behavior. Moreover, individual’s behavior intentions are affected by three factors : attitude, subjective norms, and perceived behavioral control [2].

Attitude. Attitude indicates individual’s assessment of behaviors. When assessment is more positive, the individuals are more likely to implement specific behaviors [5]. Previous studies have found that attitudes may have positive effect on privacy-protection behaviors. For example, Ho showed that adolescents’ attitudes

toward PPBs positively predicted their future PPBs [10]. When people perceive privacy protection as important, valuable, and appropriate behavior, they tend to engage in PPBs online. Hence, we posit the hypothesis as follow:

H1: Attitude is positively associated with PPBIs.

Subjective norms. Subjective norms is defined as the perceived rate of behavior and the perception that significant others want the individuals to implement the particular behavior [14]. Through previous studies, subjective norms have been shown to have a positive effect on PPBs. For example, earlier research indicated that, when significant others expected that individuals would not disclose their privacy, those individuals did not engage in sharing their confidential information [9]. In other words, if significant others expect people to engage in PPBs, those persons tend to engage in PPBs online. Hence, we propose the following hypothesis:

H2: Subjective norms are positively associated with PPBIs.

Perceived behavioral control. Perceived behavioral control indicates the perceived efficacy of an individual in the expected behavior [9]. Previous research has indicated that perceived behavioral control might had a positive influence on privacy-protection behaviors. For example, when individuals were able to perceive their behaviors, they were less likely to engage in leaking their private information online [9]. Moreover, when individuals perceive that it is easy to implement PPBs, they tend to engage in the behavior online. Hence, we propose the following hypothesis:

H3: Perceived behavioral control is positively associated with PPBIs.

2.3 An extension of the TPB: Privacy concern as an antecedent

Defined as one’s concern about his or her personal data being used, privacy concern could affect PPBIs directly and indirectly through attitude, subjective norms, and perceived behavioral control. Previous study has indicated that a positive association exists between privacy

concerns' degree and privacy-protection behaviors: the higher the degree of concern, the more likely to implement privacy-protection behaviors [10]. The relationship between privacy concerns and PPBs was initially proposed and discussed by Altman. He found that "people try to enforce the required level of privacy by using behavioral mechanisms" [1]. Privacy concerns occur frequently in the big data era. With the continuous growth and adoption of social media services and strategies, it is necessary to understand their role in individual's privacy [8].

Previous study has indicated a positive association between privacy concern and adolescents' attitudes toward PPBs [9]. Based on these, we further explore the degree to which privacy concerns are likely to have an impact on attitudes toward PPBs online. In addition, we also investigate the influence of privacy concerns on the subjective norms and perceived behavioral control. When people have strong privacy concerns, their family and friends expect them to engage in PPBs (i.e., subjective norms). If an individual has a high degree of privacy concern, her or his significant others perceive that individual as someone who wants to protect her or his personal information. As such, they expect people to engage in PPBs, and in turn, to satisfy their significant others' expectations, they are more likely to implement PPBs in order to protect their privacy online. Additionally, a high degree of concern about privacy may lead to a greater degree of attention to privacy issues, which may affect their ability and determination to implement PPBs (i.e., perceived behavioral control) and to become knowledgeable about it. Thus, such individuals can be expected to have a high degree of behavioral control over these behaviors. In summary, attention to privacy issues reflects the level of people's privacy concerns, which may affect their implementation of PPBs. Hence, we propose four additional hypotheses:

H4: Privacy concern is positively associated with attitude.

H5: Privacy concern is positively associated with subjective norms.

H6: Privacy concern is positively associated with perceived behavioral control.

H7: Privacy concern is positively associated with PPBs.

3 Method

3.1 Data Collection

During July 2022, an online survey was conducted in China to collect data. We employed the snowball-sampling technique and 637 adults were recruited. We asked participants to sign an informed consent before they accessed the questionnaire, and those who were not

willing to participate and failed to answer the filter questions correctly were excluded. We acquired 599 valid samples after eliminating the invalid questionnaires. The mean age of these 599 respondents was 28.77 years, with a range of 18–72 years old. About 39.7% had obtained a high school diploma, and 30.6% had obtained a college degree.

3.2 Measures

Based on the research background, this study adjusts the existing and effective questionnaire table. (see Table 1). First, we used Ho et al.'s (2017) attitude scale, subjective norms scale, and perceived behavioral control scale; each of these scales had three items for a total of nine items. Additionally, we adapted Mosteller and Poddar's (2017) privacy concern scale (comprising four items) to our current context. Finally, we adapted Adhikari and Panda's (2018) privacy-protection behavior intentions scale (comprising three items) to our current context. The finding showed that all scales have a good validity and reliability.

Control variables. Demographic variables were used as control variables for this research, including age and educational level.

Attitude. Attitudes were measured by three items using a five-point scale (1 = strongly disagree and 5 = strongly agree) [10]. The respondents were asked about their attitude toward engaging in privacy-protection behaviors online. A higher score indicates the greater degree of attitudes (M = 3.91, SD = 0.96, Cronbach's α = 0.87).

Subjective norms. Subjective norms were surveyed by three items using a five-point scale (1 = strongly disagree and 5 = strongly agree) [10]. The respondents were asked whether most of the people who are important to them thought that they should implement PPBs online. A higher score indicates the greater degree of subjective norms (M = 3.86, SD = 0.96, Cronbach's α = 0.87).

Perceived behavioral control. Perceived behavioral control was measured by three items using a five-point scale (1 = strongly disagree and 5 = strongly agree) [10]. The respondents were asked whether they considered themselves able to implement PPBs online. A higher score indicates the greater degree of perceived behavioral control (M = 3.88, SD = 0.93, Cronbach's α = 0.83).

Privacy Concern. The degree of attention to how to handle personal privacy information on online service providers was surveyed by four items using a five-point scale (1 = strongly disagree and 5 = strongly agree) [13]. The respondents were asked about which personal privacy issues they are concerned about when they are online. A higher score indicates a greater degree of concern about privacy online (M = 3.81, SD = 0.94, Cronbach's α = 0.88).

Table 1. Summary of measurement items (self-organized).

Study measure	Survey items	Cronbach's alpha	M	SD
Attitude [10]	Do you agree with the following statement? (1 = Strongly Disagree, 5 = Strongly Agree)	0.87		

	1. It is important to engage in PPBs online.		4.00	1.01
	2. It is necessary to engage in PPBs online.		3.85	1.12
	3. It is meaningful to engage in PPBs online.		3.87	1.10
	Do you agree with the following statement? (1 = Strongly Disagree, 5 = Strongly Agree)			
Subjective norms ^[10]	1. Most people who are important to me, they implement PPBs online.	0.87	3.95	1.02
	2. Most people who are important to me, they think I should implement PPBs online.		3.80	1.11
	3. Most people who are important to me, they expect I implement PPBs online.		3.82	1.10
	Do you agree with the following statement? (1 = Strongly Disagree, 5 = Strongly Agree)			
Perceived behavioral control ^[10]	1. It is possible for me to engage in PPBs online.	0.83	4.01	0.96
	2. It is easy for me to engage in PPBs online.		3.82	1.12
	3. It is mostly up to me whether or not I engage in PPBs online.		3.79	1.14
	Do you agree with the following statement? (1 = Strongly Disagree, 5 = Strongly Agree)			
	I am concerned that online service providers...			
Privacy Concern ^[13]	1. may keep my private information in a non-secure manner,e.g. saving my personal information on a public server.	0.88	3.91	1.01
	2. may divulge my information to unauthorized parties without my consent,e.g. authorizing my personal information to online shopping platforms and real estate companies.		3.74	1.13
	3. may use my information for other purposes without notifying me or getting my authorization,e.g.analyzing my daily activities to derive information about me and profiteering on big data.		3.80	1.11
	4. may sell my information to others without notifying me or getting my authorization,e.g. selling my personal information to P2P platforms and intermediary organ.		3.76	1.13
	Do you agree with the following statement? (1 = Strongly Disagree, 5 = Strongly Agree)			
Privacy Protection Behavior intention ^[1]	1. I will provide incomplete personal information online.	0.84	3.88	1.01
	2. I will avoid giving real and accurate personal information online.		3.75	1.13
	3. I will refuse to provide real and accurate personal information online.		3.78	1.11

3.3 Preliminary analysis

For this research, we employed the maximum likelihood estimation for the path analysis on AMOS 26.0 in order to examine hypotheses investigating the association between attitudes, subjective norms, perceived behavioral control, and privacy concerns with PPBIs. Before conducting a path analysis, we examined the study data to ensure no abnormal values, and all measure items were found to be normally distributed (kurtosis and skewness were within the range of ± 1). Moreover, we used SPSS 26.0 to conduct a reliability test on potential variables. The test results indicated that the Cronbach's alpha values of all potential variables range from 0.83 to 0.88, and all potential variables had good reliability.

4 Results

To support or refute the hypotheses, a path analysis was conducted. The path analysis showed a good fitness of the measurement model (CMIN/DF = 0.99, TLI = 0.99, CFI = 1.0, RMSEA = 0.01). The results are reported in Table 3 and Figure 2. These factors may affect individuals' PPBIs that aim to protect their online privacy. Respondents' age ($\beta = -0.01$, $p = 0.88$) was not significantly correlated to PPBIs, and their educational level ($\beta = -0.10$, $p = 0.01$) was negatively related to PPBIs. Attitude ($\beta = 0.09$, $p = 0.03$), subjective norms ($\beta = 0.11$, $p = 0.01$), and perceived behavioral control ($\beta = 0.20$, $p < 0.01$) were found to be positively related to PPBIs, thereby supporting H1, H2, and H3. Privacy concern was positively associated with attitude ($\beta = 0.34$, $p < 0.01$), subjective norms ($\beta = 0.27$, $p < 0.01$), and perceived behavioral control ($\beta = 0.31$, $p < 0.01$), thus supporting H4, H5, and H6. Finally, privacy

concerns were positively correlated to PPBIs ($\beta = 0.23$, $p < 0.01$), thus confirming H7.

Table 2. Hypotheses testing (self- organized).

Hypothesis	Path	β	P	Analysis Results
H1	Att→PPBIs	0.09	0.03	Supported
H2	SN→PPBIs	0.11	0.01	Supported
H3	PBC→PPBIs	0.20	***	Supported
H4	PC→Att	0.34	***	Supported
H5	PC→SN	0.27	***	Supported
H6	PC→PBC	0.31	***	Supported
H7	PC→PPBIs	0.23	***	Supported

Note(s): Att: Attitude; SN: Subjective norms; PBC: Perceived behavioral control; PC: Privacy Concern; PPBIs: Privacy-Protection Behavioral intentions

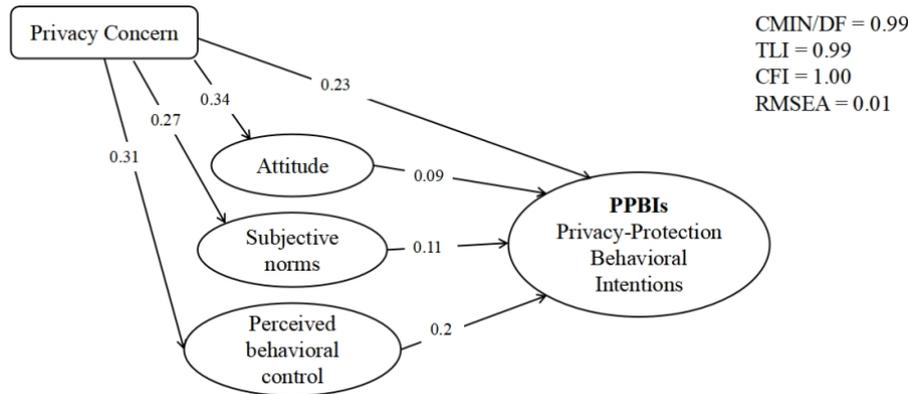


Fig. 2. Full model for PPBIs (self- organized).

Note(s): The rectangles represent observed variables and the ovals represent latent variable. The coefficients in the figure are standardized β coefficients. Age and educational level were treated as control variables.

5 Conclusions

The finding of this research supported the variables of the TPB in predicting PPBIs. Consistent with a previous study, attitudes, subjective norms, and perceived behavioral control positively affects PPBIs [10]. The finding indicated that individuals were more likely to implement PPBIs when they perceived it to be beneficial and important. The results showed that subjective norms were positively with PPBIs. And it indicated that individuals were more likely implement PPBIs if they perceived that others expect them to engage in particular behaviors. Additionally, we found that individuals' perceptions of behavioral control may result in their greater likelihood of engaging in privacy-protection behaviors if they consider themselves able to engage in PPBIs online.

This research extended the TPB by examining the influence of privacy concerns. It also explored how privacy concerns affect PPBIs directly and indirectly via attitude, subjective norms, and perceived behavioral control. The finding indicates that privacy concerns do, indeed, motivate individuals to engage in privacy-protection behavioral intentions directly and indirectly via attitude, subjective norms, and perceived behavioral control. Specifically, we found that privacy concerns influence individuals by generating the positive attitudes toward privacy-protection behaviors and by shaping subjective norms and perceived behavioral control, which

lead, in turn, to behaviors that are aimed at protecting their privacy online.

6 Discussion

The findings suggest that this study has theoretical contribution and practical significance. The theoretical contribution is mainly reflected in extending the TPB by taking privacy concern as an antecedent to explore how it influences attitudes, subjective norms, and perceived behavioral control, consequently affecting PPBIs. Furthermore, in regard to the behavioral component of privacy concerns, it was found that attitudes, subjective norms, and perceived behavioral control significantly mediate the association between privacy concerns and PPBIs. Finally, this research found that the positive association between privacy concerns and privacy-protection behavioral intentions if they knew how to handle their private information in relation to online service providers. This will provide a reference for online service providers with privacy-protection measures.

This research has several significance. This study analyzes cross-sectional data to prevent causal inference. In future research, we may increase longitudinal surveys with the aim of clarifying causation. Secondly, this study employed snowball sampling to recruit respondents. Thus, further research utilizing a representative sample is necessary in order to make research more universal and persuasive.

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