

Research on Perceived Information Privacy Threats and Coping Strategies of Personal Cloud Storage Users (Postprint)

Authors: Lu Xinman, Li Yanxia, Zhang Chubing

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Abstract

Purpose and Significance: In ubiquitous information environments, the inherent sharing nature of cloud services, personalized service processes, and ubiquitous access continuously intensify privacy threats to users. Exploring the attenuating factors of users' perceived threat and their coping strategies will facilitate analysis of complex information protection behaviors in such environments, thereby promoting the further development and large-scale adoption of cloud storage services.

Methodology: Grounded in optimism bias and coping theory from psychology, this study follows the research logic of attenuating factors → perceived threat → coping strategies. It analyzes the differential effects of three dimensions—optimism bias, usage experience, and official certification—on cloud storage users' perceived threat, and verifies the moderating role of optimism bias in the relationship between perceived threat and coping strategies. Data were collected through an online questionnaire survey, and Partial Least Squares (PLS) was used to estimate the structural model.

Findings and Conclusion: The results indicate that usage experience and optimism bias negatively influence perceived threat, while the effect of official certification is not significant. Moreover, optimism bias negatively moderates the relationship between perceived threat and problem-focused coping, but does not affect its relationship with emotion-focused coping. These findings help reveal the occurrence patterns and underlying mechanisms of cloud storage users' perceived threat and coping strategies, and provide recommendations for risk management and control by cloud service providers as well as for regulatory policies by national industrial and information technology authorities.

Full Text

Research on Personal Cloud Storage Users' Information Privacy Perceived Threats and Coping Strategies

Lu Xinman¹, Li Yanxia¹, Zhang Chubing² ¹School of Management Science and Engineering, Tianjin University of Finance and Economics, Tianjin 300222
²Business School, Tianjin University of Finance and Economics, Tianjin 300222

Abstract

[Purpose/Significance] In ubiquitous information environments, the shared nature of cloud environments, personalized service processes, and ubiquitous access continuously increase users' privacy threats. Exploring the weakening factors of users' perceived threats and their coping strategies will help analyze users' complex information protection behaviors in ubiquitous information environments and promote the further development and large-scale application of cloud storage services.

[Method/Process] Integrating optimistic bias and coping theories from psychology, and based on the research logic of "weakening factors → perceived threat → coping strategy," this study analyzes the different influences of three dimensions—optimistic bias, usage experience, and official certification—on cloud storage users' perceived threats, and verifies the moderating effect of optimistic bias on the relationship between perceived threat and coping strategies. Through an online questionnaire survey, the structural model was estimated using partial least squares.

[Result/Conclusion] The findings reveal that usage experience and optimistic bias negatively affect perceived threat, while the effect of official certification is not significant. Additionally, optimistic bias negatively moderates the relationship between perceived threat and problem-focused coping, but does not affect its relationship with emotion-focused coping. The results can help reveal the patterns and internal mechanisms of perceived threats and coping strategies among cloud storage users, and provide recommendations and references for risk management by cloud service providers and regulatory policies by national industry and information technology authorities.

Keywords: Personal cloud storage; Coping; Perceived threat; Optimistic bias

1. Introduction

Ubiquitous information services have ushered in a new era of information services, providing novel opportunities for enterprises to achieve user interaction, collect relevant information, eliminate spatiotemporal constraints, and thus establish closer user relationships by leveraging existing information technologies.

Currently, ubiquitous information services are widely applied in healthcare, retail, transportation, banking, and other fields, offering users more customized and personalized services [1].

However, cloud storage failures pose significant threats to user privacy security and expose cloud service providers to technical, management, operational, legal, and regulatory risks [2-3]. For instance, in January 2019, the cloud storage service company MEGA leaked 87GB of data containing approximately 12,000 files, including 770 million email addresses and about 21 million unique passwords. In August 2018, Tencent Cloud was sued for over 10 million RMB for leaking user data from Beijing Qingbo CNC Technology Co., Ltd. In September 2017, an Amazon cloud storage repository leaked 47GB of medical data, exposing personal sensitive information of at least 150,000 patients.

Data information in cloud storage products, especially sensitive information, involves fundamental rights such as individual freedom, personal dignity, and integrity. Therefore, identifying risk weakening factors to reduce users' information privacy perceived threats and influence their subsequent coping strategies has become an urgent challenge in personal cloud storage.

Current research on cloud service security and risks focuses primarily on cloud data storage security (confidentiality, integrity, availability) [4-5], service risks (product and service compatibility) [6-7], technical risks (encryption/decryption mechanisms, virtualization vulnerabilities) [6,8], process risks (service innovation, IT governance) [6,9], and cloud service provider selection [10]. However, two important issues remain unresolved: (1) Most studies adopt technical or enterprise perspectives [3], lacking research from individual user perspectives on cloud storage risk perception; (2) Research on coping strategies when users face new cloud storage service risks is relatively scarce. Although coping theory has made progress in multiple fields, scholars have mostly focused on coping appraisal [11], with few studies in personal cloud storage examining individual coping strategies from a threat appraisal perspective, and even fewer comprehensive studies simultaneously examining both problem-focused coping [11-12] and emotion-focused coping [13-14].

Therefore, based on existing research gaps, this study draws upon optimistic bias and coping theories to reveal the patterns and internal mechanisms of users' perceived threats and coping strategies regarding personal cloud storage services in ubiquitous information environments.

2. Literature Review

2.1 Optimistic Bias Theory Under Perceived Threat Users face various risks and threats from internal and external sources when using cloud storage services. C. Vlek and P.J. Stallen [17] define risk as the probability of loss occurrence. P.W. Wirtz and C.A. Rohrbeck [18] propose that perceived threat

(PT) is users' awareness of dangerous situations—the likelihood that users believe measures are necessary when facing an event.

Optimistic bias (OB) is a phenomenon where some individuals believe they are more likely to experience positive events while others are more likely to encounter negative events. N.D. Weinstein first proposed and verified this concept, terming it “unrealistic optimism” —a psychological perception bias when people perceive threats. Perceived threat is subjective and contextual, leading people to compare their personal threat perception with group target threats. Underestimating one's own risk creates optimistic bias [19].

As shown in Table 1, optimistic bias is prevalent across many domains. Existing research has confirmed varying degrees of optimistic bias in cloud services [16]. While most literature examines how optimistic bias affects users' cloud adoption behavior from an overall cloud data security perspective, some scholars have demonstrated the existence of optimistic bias in cloud data security risk perception across confidentiality, integrity, and availability dimensions, analyzing its impact on users' security management decisions [16]. As China gradually enters the information society, no scholars have yet verified how personal cloud storage users' information privacy perceived threats and their subsequent coping strategies are affected in this ubiquitous interconnected sharing environment—this is one of the issues this paper addresses.

2.2 Coping Theory Coping is a complex concept with two perspectives in psychological literature: process view and style view. The process view defines coping as ongoing cognitive and behavioral efforts to manage specific external or internal demands when individuals face fearful, stressful, and threatening situations [23]. In contrast, the style view considers coping as a personal style for managing and maintaining psychological integrity when facing threats. The process view offers advantages over the style view in terms of being less limited and static [23].

Based on early coping research, H. Liang and Y. Xue [11] proposed the Technology Threat Avoidance Theory, suggesting that individual technology threat coping includes threat appraisal and coping appraisal, and elaborated the relationship between these assessments and coping strategies. Cloud storage risk is also a technology threat, making their theoretical framework applicable. While the theory proposes two assessment perspectives, this study focuses on threat appraisal rather than coping appraisal for two reasons: (1) In personal cloud storage contexts, once a cloud storage service failure occurs, the resulting risks and threats are rapidly amplified and widely disseminated, making users' threat appraisals quantifiable and comparable; (2) Although scholars have accumulated research findings on coping appraisal processes in other technology threat domains, threat appraisal research remains scarce due to its context-dependent nature. Additionally, this study introduces the Ministry of Industry and Information Technology's Trusted Cloud Service Certification as a social influence factor, rather than peer influence or social relationships, which aligns with the

national context of promoting cloud computing industry standards to help users choose trustworthy and secure cloud services, while also addressing the unexplored role of state-led third-party certification in users' perceived threat and coping processes.

3. Research Model and Hypotheses

This study builds upon coping theory and integrates the Technology Threat Avoidance Theory, treating optimistic bias as both an independent and moderating variable. Additionally, S. Bamberg et al. [28] found that usage experience affects individuals' perceived threat, which in turn influences their coping intentions or strategies. In the cloud storage context, users' usage experience is one of the key elements affecting cloud service optimization, and the experience formed during usage influences their risk perception of the product. Therefore, this study also introduces usage experience as a variable, and the conceptual model is shown in Figure 1 [Figure 1: see original paper].

3.1 Official Certification, Usage Experience, and Perceived Threat In information services, when information risks occur, rational information users assess their perceived threats and select appropriate coping strategies [25]. Threat is defined as harm to self-concept [29]. Cloud service failures severely constrain the development of personal cloud storage, with amplified perceived threats becoming the biggest obstacle to adoption. R.F. Baumeister and L. Smart [30] noted that threat occurs when self-serving viewpoints are questioned, accused, or ridiculed. Perceived threat represents a perceived discrepancy between current and end states—an uncomfortable or aversive state caused by actual outcomes [31]. In personal cloud storage, perceived threat typically refers to threats from file loss, sensitive data access [32], etc.

In psychological resilience research, threat factors can be divided into external and internal factors based on their sources. External factors are non-individual factors at the social level, such as social loneliness and social belonging [33], social identity threat [34], website credentials [35], etc. Internal factors are primarily individual factors, including individual needs, experience [36], and optimistic bias [15]. For users, data stored in the cloud is beyond their direct supervision and protection, placing cloud data at risk. Previous research shows that official certification (OC) at the external dimension, such as website credentials and third-party regulatory audits, can not only reduce consumers' perceived threats [37] but also help enterprises build image and gain user recognition. As an authoritative official representative institution in China, the Ministry of Industry and Information Technology's official certification can weaken users' perceived threats from an external perspective.

People develop experience through contact with objective things via sensory organs, forming knowledge about objective things and external connections. Expe-

rience is frequently considered in threat assessment across various domains [28]. When facing risks, usage experience helps individuals make judgments. Previous studies indicate that usage experience can effectively weaken individuals' perceived threats. For example, Y. Hoffman and T. Rosenbloom [36] found that driving experience can simultaneously weaken implicit and explanatory threats. In cloud computing contexts, scholars have also demonstrated that cloud service experience can significantly reduce users' product risk perception [38]. Additionally, in surveys of cloud computing solutions, S. Singh et al. [37] noted that consumer experience can effectively reduce unnecessary worries among cloud users. Based on these analyses, this study proposes:

H1: Official certification obtained by cloud service providers negatively affects personal cloud storage users' perceived threat.

H2: Personal cloud storage users' usage experience negatively affects their perceived threat.

3.2 Coping Strategies According to coping theory, individuals adopt corresponding coping strategies based on threat assessment results. Previous research shows that threat assessment can help people become more rational and reduce risky behavior. When aware of threats, people increase their self-protection awareness and willingness to adopt coping strategies. H. Liang and Y. Xue [11], within the Technology Threat Avoidance Theory framework, noted that perceived threat is the result of threat appraisal, and that perceived threat affects both individuals' problem-focused coping and emotion-focused coping. Perceived threat positively influences both coping strategies for two reasons. First, perceived threat affects problem-focused coping to some extent. When facing risks, people typically adopt protective behaviors to avoid harm. For example, M.T. Schmitt et al. [39] found that perceived threat effectively promotes environmental protection behaviors among U.S. and Canadian citizens when facing ecological threats. Second, perceived threat also promotes emotion-focused coping to some degree [40], such as R. Delahaj and K.V. Dam [14] using emotion-focused coping to relieve stress for high-risk professionals. In cloud storage failure contexts, when users perceive high threats during threat assessment, they may choose problem-focused coping strategies like encrypting uploaded data and backing up data, while also using emotion-focused coping strategies to vent dissatisfaction [40].

Therefore, this study maintains that perceived threat positively influences both users' problem-focused and emotion-focused coping, proposing:

H3a: Personal cloud storage users' perceived threat positively affects problem-focused coping.

H3b: Personal cloud storage users' perceived threat positively affects emotion-focused coping.

3.3 Optimistic Bias Previous threat assessment research has yielded a robust finding: when facing identical situations, people tend to judge their own risk of encountering threats as relatively lower than others' [41]. This biased judgment may result from optimistic bias [35] and the multidimensional nature of risk judgment. N.D. Weinstein [41] noted that individuals tend to interpret risks in a "self-serving" manner because they believe others are relatively more vulnerable and more likely to encounter risks. This tendency is called optimistic bias or unrealistic optimism. Research shows this unrealistic optimism is robust across various threat assessment domains. For instance, optimistic bias exists when people judge the likelihood of car accidents, earthquakes, and negative online events [15]. H. Cho et al. [15] found that in online privacy risks, individuals tend to believe they are less likely than others to encounter risks, and that stronger optimistic bias leads to fewer perceived network risks. Cloud service research shows that personal cloud storage, as a network service, also exhibits optimistic bias, where greater negative optimistic bias (pessimistic bias) leads to greater perceived threat and stronger willingness to take measures [16].

In summary, optimistic bias is closely linked to threat perception [15,42]. Optimistic bias affects users' risk judgments about personal cloud storage and weakens their perceived threats. Therefore, this study proposes:

H4: Personal cloud storage users' optimistic bias negatively affects their perceived threat.

Optimistic bias is a relatively stable cognitive bias when individuals judge risks and threats. This stable, individual-related cognitive bias can connect users' perceived threats with coping strategies. People with optimistic bias generally believe risks are controllable—the higher the perceived control, the greater the optimistic bias. In other words, optimistic bias affects individuals' risk perception and perceived control levels. When using personal cloud storage, high optimistic bias can bring users a greater sense of security, which simultaneously hinders protective measures. When cloud storage users have high optimistic bias, the stimulating effect of perceived threat is weakened, leading users to adopt "risk-taking behavior." Thus, optimistic bias reveals the relationship between individuals' perceived threats and coping strategies [43]. People with low optimistic bias tend to believe risks are uncontrollable, perceive relatively higher threats, and adopt coping strategies more actively [43]. Those with high optimistic bias tend to underestimate the difficulty of implementing control, especially when behavioral change is required [15], believe risks are controllable, perceive relatively lower threats, and are more likely to adopt passive coping strategies. Therefore, the effect of perceived threat on coping strategies is weaker for high optimistic bias users and stronger for low optimistic bias users. Given the risk uncertainty in cloud services, the level of optimistic bias is particularly important in personal cloud storage. High optimistic bias not only directly affects individuals' perceived threats but also moderates the relationship between users' perceived threats and coping strategies. This study therefore proposes that optimistic bias negatively moderates the effect of perceived threat on coping strategies:

H5a: Personal cloud storage users' optimistic bias negatively moderates the effect of perceived threat on problem-focused coping.

H5b: Personal cloud storage users' optimistic bias negatively moderates the effect of perceived threat on emotion-focused coping.

4. Research Design

4.1 Variable Measurement By adapting existing mature scales, this study employed a five-point Likert scale to measure six latent variables, as shown in Table 2 .

4.2 Data Collection This study distributed questionnaires online via Wenjuanxing, using screening questions to ensure respondents had used or were familiar with personal cloud storage products. A total of 325 questionnaires were distributed. After eliminating invalid online questionnaires (e.g., those with inconsistent trap questions), 245 valid questionnaires were recovered, yielding a 75.4% valid response rate—9.4 times the number of observed variables, meeting structural equation modeling requirements. The sample' s demographic characteristics are shown in Table 3 . The survey targeted students and enterprise/institution employees, as they have certain information knowledge and needs for personal cloud storage due to daily study and work requirements. Ages 18-23 accounted for 48.6%, ages 24-29 for 45.1%, and those with information professional backgrounds for 59.6%.

5. Data Analysis and Results

5.1 Reliability and Validity Analysis As shown in Table 4 , measurement model analysis in PLS revealed all latent variables' Cronbach' s Alpha coefficients between 0.6-0.8, indicating good internal consistency reliability. Composite reliability (CR) exceeded 0.7, demonstrating good internal consistency. All latent variables' AVE values were above 0.5, meaning latent variables explained over 50% of observed variables' variance, indicating good convergent validity.

For discriminant validity, this study followed the Fornell-Lacker criterion. Table 5 shows AVE square roots on the diagonal and correlation coefficients between latent variables off-diagonal, demonstrating good discriminant validity.

5.2 Hypothesis Testing To test the seven hypotheses, SmartPLS 2.0 M3 was used to analyze latent variable paths and moderating effects. R^2 values reflect the variance explained by predictor variables. R.F. Falk and N.B. Miller [49] note that R^2 above 10% is acceptable, while J.F. Hair, C.M. Ringle, and M. Sarstedt [50] suggest that in consumer behavior, R^2 exceeding 0.2 indicates good fit. As shown in Figure 2 [Figure 2: see original paper], perceived threat

variance explanation was 36.4%, emotion-focused coping 24.7%, and problem-focused coping 12.9%, indicating high explanatory power.

5.2.1 Structural Model Path Analysis Using SmartPLS' s bootstrap method with 245 cases and 5,000 samples, path coefficients were obtained. Results showed that except for official certification' s non-significant effect on perceived threat ($\beta = -0.019$, $p > 0.05$), both optimistic bias ($\beta = -0.427$, $p < 0.001$) and usage experience ($\beta = -0.324$, $p < 0.001$) significantly affected perceived threat. H1 was not supported for three possible reasons: (1) Personal cloud storage users currently lack deep understanding of Trusted Cloud Service Certification, and cloud storage software does not prominently display certification marks; (2) Official certification represents past positive affirmation of personal cloud storage but cannot significantly weaken perceived threats from cloud service risks; (3) Even authoritative or national official departments may experience data leaks, causing users to doubt official certifications.

Additionally, perceived threat' s effect on emotion-focused coping ($\beta = 0.317$, $p < 0.001$) was more pronounced than on problem-focused coping ($\beta = 0.199$, $p < 0.001$). This is because problem-focused coping requires technical capability, and users decide based on "cost-benefit" considerations whether to invest time, technology, or money. Emotion-focused coping requires less investment, and in the new media era, universal information participation also prompts users to adopt emotion-focused coping strategies.

5.2.2 Moderating Effect Analysis Results showed optimistic bias significantly moderated the relationship between perceived threat and problem-focused coping ($\beta = -0.163$, $p < 0.05$), but not the relationship between perceived threat and emotion-focused coping ($\beta = 0.294$, $p > 0.05$). This indicates that under high optimistic bias, the relationship between perceived danger and problem-focused coping significantly decreases, while the relationship with emotion-focused coping remains unaffected. Analysis reveals that optimistic bias reduces perceived threat. However, once cloud data risk is overestimated, users' willingness to adopt emotion-focused coping also increases. Research also shows intrinsic connections between optimistic bias and emotion, with mutual influence, which may explain the non-significant moderating effect.

6. Conclusions and Implications

This study analyzed the different effects of optimistic bias, usage experience, and official certification on perceived threat and verified optimistic bias's moderating role. Main contributions include:

(1) Significant contribution to exploring antecedent weakening factors of cloud storage users' perceived threat. First, building upon verification of optimistic bias' s existence in cloud services, this study further examined its

negative effect on users' perceived threat. Second, unlike previous literature focusing on how official certification enhances user trust, this study analyzed its weakening effect on perceived threat from a user perspective, finding this effect insignificant in personal cloud storage.

(2) Supplementing and extending coping theory application in cloud storage services. Coping theory has made substantial contributions in psychology, organizational behavior, and consumer research. Personal cloud storage represents a new IT application field with limited research on user coping strategies. This study innovatively focuses on the threat appraisal perspective of Technology Threat Avoidance Theory, considering both problem-focused and emotion-focused coping. Findings show perceived threat is a primary factor influencing coping strategies. When perceived threat is high, users adopt both problem-focused strategies (e.g., encryption, backup) and emotion-focused strategies (venting dissatisfaction), with emotion-focused coping being more pronounced. This expands coping theory' s application domain.

(3) Clarifying optimistic bias' s moderating effect on the perceived threat-coping relationship. In ubiquitous information service contexts, optimistic bias leads users to enjoy rich information services while worrying about data security risks. Building on Wang Zhiying et al. [16], this study analyzed optimistic bias' s moderating effect, supplementing cloud storage user information security psychology.

Practical implications: For cloud service providers, (1) guide users through free trials to accumulate robust usage experience and overcome irrational perceived threats; (2) reasonably guide users to establish data risk security awareness, avoiding optimistic bias-induced threat perception deviations, and guide appropriate coping strategies based on optimistic bias levels. For government, third-party official certification has not yet achieved expected effects in reducing perceived threat, requiring further market maturation and development of China' s cloud service certification system. Although government supervision exists, certification quality and effectiveness need improvement.

Limitations: First, this study does not comprehensively examine perceived threat' s influencing factors—future research could consider corporate reputation, perceived sensitivity, threat severity, etc. Second, the intrinsic connection between optimistic bias and emotion limited moderating effect validity; understanding their mechanism would help accurately parse cloud storage users' security risk cognition and coping mechanisms.

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Author Contributions

Lu Xinman: Paper topic selection, research framework design, final paper writing and completion

Li Yanxia: Questionnaire survey, data analysis, initial paper drafting

Zhang Chubing: Research idea adjustment, paper revision guidance

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