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# How User Information Assurance Influences Perceived Information Control in Cloud Storage Service: A Self-Determination Perspective

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## ABSTRACT

This study examines the underlying mechanisms through which user information assurance, including technology-based assurance and institution-based assurance, affects users' perception of information control in cloud storage service. We argue that user information assurance represents an external motivation that has to be internalized in order to motivate a person to voluntarily use cloud storage to keep personal information. Drawing upon the self-determination theory, we hypothesize that perceived autonomy, perceived competence and perceived relatedness, three fundamental psychological needs, mediate the impact of user information assurance on perceived information control, which then drives user intentions to adopt cloud storage service. The mediating effect is also examined for the impact of information assurance on perceived benefit. An empirical study confirms our expectations. Implications for research and practice are discussed.

## Keywords

Cloud storage service, user information assurance (UIA), self-determination theory, perceived information control, perceived autonomy, perceived competence, perceived relatedness.

## INTRODUCTION

As a major form of cloud computing, cloud storage service is growing very fast and brings benefits such as on-demand service, ubiquitous access, rapid resource elasticity, and usage-based pricing (Mell and Grace, 2011). However, concerns about user information privacy and security have also been raised regarding the unauthorized duplication, dissemination, and deletion of data stored on the cloud (Caldwell, 2012). Unlike local storage, cloud storage operates in a multi-tenant environment which relinquishes users' ultimate control over the fate of their information. How to enhance their perceptions of information control has become an essential task for the flourish of cloud storage service.

The literature suggests that user information assurance (UIA), defined as the interventions that a company devotes to protecting user information, may enhance user perceptions of information control (Xu, Dinev, Smith and Hart, 2011). However, how and why it works has yet been clearly specified, as reflected in conflicting empirical evidences (Hu, Wu, Wu and Zhang, 2010; Kim and Benbasat, 2006; Morton and Sasse, 2012). To advance the literature, we draw upon the self-determination theory (SDT; Deci and Ryan, 2000). SDT suggests that the satisfaction of innate psychological needs of individuals influences their perceived control of an activity and the motivation to perform the activity (Deci and Ryan, 2000). The motivation, such as using cloud storage service, is undermined when people feel controlled or compelled by others (Sheldon, Tuban, Brown, Barrick and Judge, 2003). As such, a proper understanding of what the individuals' innate psychological needs are influenced by information assurance mechanisms and then conducive to perceived information control is critical to the design and development of UIA by cloud storage service providers.

The objective of the study is to examine the role of psychological needs satisfaction in the relationship between information assurance and perceived information control (as well as perceived benefits). An empirical study on Taiwanese subjects confirms our expectations that psychological needs satisfaction mediates the impacts of information assurance on perceived information control and perceived benefit, which then influence the adoption intention of cloud storage service. Of the three components of psychological needs, perceived autonomy and perceived relatedness exhibit strongest impact, calling for more attention to these constructs.

## THEORETICAL BASIS AND HYPOTHESES DEVELOPMENT

### Theoretical Basis

People have concerns about the privacy and security of their personal information in cloud storage service as they are uncertain about what information will be collected or used by the service providers. Such a feeling of lack of control of personal information refrains people from adopting cloud storage service or maximizing its value. A common approach to enhancing individuals' perceived information control is the establishment of user information assurance (or UIA) mechanisms, such as privacy policies (Xu et al., 2011) and privacy-preserving technologies (Kobsa, 2007). However, the assumption that awareness of UIA would change people's perceptions about privacy and security is unwarranted (Kim, Steinfield and Lai, 2008), as people may respond differently to the external stimuli. Such an internalization process is best described in the self-determination theory or SDT.

SDT proposes that individuals strive to satisfy their basic psychological needs before carrying out a volitional task. The psychological needs, described as "innate psychological nutrients that are essential for ongoing psychological growth, integrity and well-being (Deci and Ryan, 2000, p. 229)," represent motivational dispositions that energize individuals and orient them toward valued possibilities (Elliot, McGregor and Thrash, 2004). Three fundamental psychological needs have been recognized, including perceived autonomy, perceived competence, and perceived relatedness (Ryan and Deci, 2002). Perceived autonomy refers to the experienced feeling of initiative and freedom to behave in accordance with one's sense of self. It is regarded as a form of self-government, or the extent to which individuals feel that actions taken are volitional (Ryan and Deci, 2002). Autonomous individuals experience psychological freedom and ownership of his or her actions. Perceived competence refers to feeling effective in one's ongoing interaction with the environment and experiencing opportunities to exercise and express one's capacities (Ryan and Deci, 2002). It represents effectance motivation which represents an organismic propensity impelling individuals to investigate and master the environment. Perceived relatedness refers to feeling respected and cared for by others (Sheldon et al., 2003). It affords a person's "secure base" to engage or participate in the environment.

Central to SDT is the proposition that the social context influences an individual's psychological well-beings and behaviors. In term of cloud storage service, we suggest that a feeling of autonomy, competence, and relatedness constitutes the internal motivation of a person to use the service, and external environmental factors (such as UIA mechanisms) would have an influence on needs satisfaction. In the next section, we develop hypotheses to examine the role of SDT in the relationships between UIA, perceived information control, and perceived benefit.

### Hypotheses Development

#### *User Information Assurance (UIA) and Psychological Needs Satisfaction*

We first examine the impact of UIA on users' psychological needs satisfaction. Regarding technology-based assurance, we suggest that it enhances a person's perceived autonomy, competence, and relatedness in manipulating personal information. Technology-based assurance makes information collection transparent, offers users the option to opt-in or opt-out, and makes it possible to manage personal information. These mechanisms enhance the users' autonomy in controlling their personal information. Meanwhile, technology-based assurance includes various privacy enhancing technologies (or PET) such as encryption, third-party certification, and feedback that safeguard personal information. Encryption technology ensures that personal information is collected and used by authorized rather than unauthorized entities. Third-party certification such as privacy seals attest that the privacy practice of an organization is effective and complies with its privacy statements. PET may also provide feedback on how end users' personal information is collected and used. This subsequently makes users feel that they are capable and effective in protecting their private information when engaging in cloud storage service. Finally, technology-based assurance helps to fulfill the need for relatedness. Well-developed technologies enable users to develop secure attachment relationship with those technologies which makes them feel confident and less anxious when carrying out tasks.

Similarly, institution-based assurance such as privacy policies (Xu et al., 2011) helps to establish a supportive surrounding that promotes the satisfaction of intrinsic needs. Institution-based assurance provides meaningful information that allows end users to make decisions according to their preferences and free will. Institution privacy protection measures also provide choices that enable end users to specify what information will be collected and how they can control their personal information. Finally, the presence of a variety of institution-based assurance measures signals that the service provider respects end users' concern about the collection and use of their personal information.

We suggest that technology-based assurance and institution-based assurance must work in tandem, and none of them would be

successful without the support of the other (Rubinstein and Good 2013). Therefore, we propose a higher order construct called information assurance that encompasses both, and propose the following hypotheses:

- H1a: User Information Assurance is positively associated with perceived autonomy in cloud storage service.
- H1b: User Information Assurance is positively associated with perceived competence in cloud storage service.
- H1c: User Information Assurance is positively associated with perceived relatedness in cloud storage service.

#### *Needs Satisfaction and Perceived Information Control*

SDT has proposed that control is a function of autonomy and is only likely to motivate action under conditions of high autonomy (Deci and Ryan, 1985). Those who feel that their behavior originates from themselves and experience their actions as “their own” perceive a sense of control over their actions. On the contrary, individuals who feel forced and compelled to take part in a behavior may perceive lack of control because they have no choice but to comply. End users with high perceived competence in technologies feel less helpless in a cloud storage environment and experience more confidence in determining the amount of information that service providers could collect and the way they interact with cloud storage technologies.

Prior studies have shown that the sense of security can be achieved through a variety of assurance mechanisms, institutional or technological (Culnan and Bies, 2003). The presence of these assurance mechanisms provide a secure and socially supportive environment. As such, a sense of control is likely to develop because end users feel less risky in disclosing personal information and more certain about its subsequent use as choices, such as opt-in and opt-out, are available to manage personal information. We therefore propose the following:

- H2a: Perceived autonomy is positively associated with perceived information control in cloud storage service.
- H2b: Perceived competence is positively associated with perceived information control in cloud storage service.
- H2c: Perceived relatedness is positively associated with perceived information control in cloud storage service.

#### *Needs Satisfaction and Perceived Benefit*

We suggest that needs satisfaction also influences perceived benefit of cloud storage service. Although cloud computing offers on-demand service and other benefits such as mobility, flexibility, and scalability (Marston, Bandyopadhyay, Zhang and Ghalsasi, 2011), these benefits cannot be fulfilled without users’ autonomy in selecting and using the service. When users can freely determine how their documents are managed without any restriction, they may believe the service is of high values. Then, perceived competence encourages users to explore the various features of cloud storage service and maximize its potential values, leading to enhanced perception of benefit. When a person has a higher perceived competence, he or she would be more confident with the use of cloud storage service and capable of realizing its full potentials. Thirdly, perceived relatedness influences perceived benefit. With perceived relatedness, the user feels cared about and thus confident with the services provided by the vendor. Otherwise the user would believe the service provider may take opportunistic behavior to mishandle user’s personal information. Thus, we hypothesize the following:

- H3a: Perceived autonomy is positively associated with perceived benefit in cloud storage service.
- H3b: Perceived competence is positively associated with perceived benefit in cloud storage service.
- H3c: Perceived relatedness is positively associated with perceived benefit in cloud storage service.

#### *Impact of Perceived Information Control and Perceived Benefit on Adoption Intention*

Users' psychological perception of control contribute to their intention for an actual behavior. Once the personal information is uploaded to the cloud it relies on service provider to manage. Consumers with high perceived control tend to have lower levels of anxiety and thus feel more intentional to use cloud storage service as a medium to host their information. We therefore hypothesize that:

- H4: Perceived information control is positively associated with the intention to use cloud storage service.

The impact of perceived benefit on the adoption of cloud storage service can be interpreted from the utility maximization perspective (Li 2012), as individuals have the intention to maximize the benefits of online storage service such as financial gains, mobility, flexibility, and scalability (Marston et al., 2011). Thus, we hypothesize that:

- H5: Perceived benefit is positively associated with the intention to use cloud storage service.

The research model, along with the test results, is presented in Figure 1.

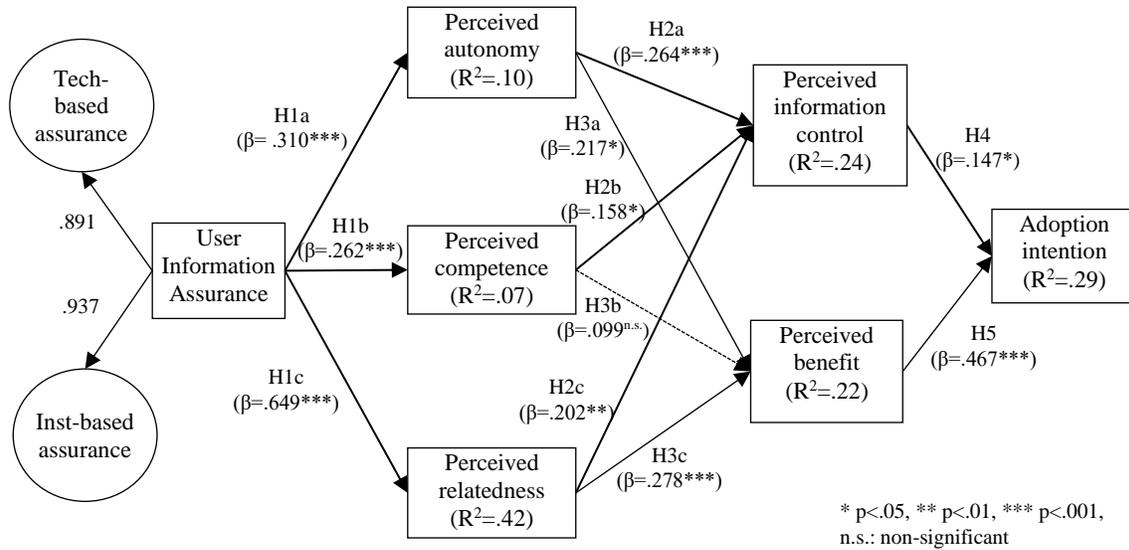


Figure 1. Research model and test results

RESEARCH METHOD AND RESULTS

Research Method

We conducted a survey to collect data to empirically test the hypotheses. Measurements items were developed from extant literature.<sup>1</sup> For technology-based assurance, four items were adopted from Chandra, Srivastava and Theng (2010) and Li, Hess and Valacich (2008) to assess perceptions of the protective technologies offered by the online storage service providers. Three items were adopted from Xu et al. (2011) to measure institution-based assurance. For psychological needs, items were developed from relevant literature, including four items measuring perceived autonomy, four items measuring perceived competence, and another four items measuring perceived relatedness. For the perceived information control, we adapted a four-item scale developed by Xu et al. (2011). Five items measuring perceived benefits were adopted from Chandra et al. (2010). Finally, items measuring customers’ intentions to adopt cloud storage services were adopted from Gefen and Straub (2000).

The original questionnaire was firstly examined by a faculty member and a Ph.D. student in MIS. The instrument was modified based on their feedback. The questionnaire was then translated into Chinese by the authors working in tandem and validated by an independent researcher who is fluent in both English and Chinese. The validated Chinese survey was then translated back into English to ensure semantic identity. Some minor revisions were carried out. Five college students were then invited to perform the Q-sorting. The Cohen’s Kappa scores for each pair of judges are between 80%-90%, and the overall inter-rater agreement is 85%, indicating adequate inter-judge reliability. The rates of correct classification range from 83% to 100% with an overall 92.6% accuracy ratio, indicating strong scale validity.

The survey was administered to students majoring in MIS at a leading private university in Taiwan. Observations that were not usable due to contradicting responses were removed from the data set. The data set consists of 246 usable observations.

Data Analysis and Results

Test of measurement items

The psychometric properties of the measurement items, including the Internal Consistency Reliability (ICR; using Cronbach’s alpha), Composite Reliability (CR) and Average Variance Extracted (AVE), were first examined. Results are reported in Table 1. All latent constructs exhibit acceptable reliability, with both ICRs and CRs above the 0.7 level (Fornell and Larcker, 1981). We further tested the data for potential common method bias (Podsakoff, MacKenzie, Jeong-Yeon and Podsakoff, 2003). Using

<sup>1</sup> Measurement items are available upon request.

Harman's single-factor test, we found that an unrotated exploratory factor analysis on the manifest variables generated a first factor that explained 48% of the total variances, less than the cutoff value of 50% (Podsakoff et al., 2003). This test suggested the lack of common method bias.

	ICR	CR	AVE	IBA	TBA	Auto.	Comp	Rela.	Info.	Bene	Inte.	Assu.
IBA	0.917	0.947	0.857	<b>0.926</b>								
TBA	0.944	0.960	0.857	0.677	<b>0.926</b>							
Autonomy	0.889	0.923	0.751	0.299	0.274	<b>0.866</b>						
Competence	0.913	0.939	0.793	0.270	0.217	0.569	<b>0.891</b>					
Related	0.876	0.915	0.729	0.595	0.595	0.350	0.326	<b>0.854</b>				
Info Control	0.943	0.959	0.855	0.331	0.258	0.424	0.374	0.346	<b>0.924</b>			
Benefit	0.909	0.932	0.732	0.491	0.352	0.371	0.313	0.386	0.330	<b>0.855</b>		
Intention	0.936	0.954	0.840	0.381	0.359	0.298	0.248	0.430	0.301	0.515	<b>0.916</b>	
Assurance	0.935	0.947	0.721	0.891	0.937	0.310	0.262	0.649	0.316	0.450	0.402	<b>0.849</b>

Note: Assurance is the second-order construct; IBA – Institution-based Assurance, TBA – Technology-based Assurance, ICR – Internal Consistency Reliability (Cronbach's  $\alpha$ ), CR – Composite Reliability; AVE – Average Variance Extracted; values on the diagonal of the correlation matrix are the square root of the AVEs.

**Table 1. Psychometric properties and correlations of the latent constructs**

#### Test of hypotheses

The Partial Least Squares (PLS) method was used to test the research model. For the second-order UIA construct, we used the repeated measurement method (Gefen, Rigdon and Straub, 2011) with two reflective sub-dimensions (i.e., technology-based assurance and institution-based assurance). The research model was estimated using the bootstrapping procedure in SmartPLS (Ringle, Wende and Will, 2005), with 500 resamples. Test results, including standardized path coefficients, significance levels, and the  $R^2$  of endogenous variables, are reported in Figure 1. All hypotheses are supported except H3b.

#### Post-hoc analysis

Fundamental to the research model is the argument that needs satisfaction, including perceived autonomy, perceived competence and perceived relatedness, mediates the impact of information assurance on perceived information control and perceived benefits. To verify this point, we conducted a series of analysis following Baron and Kenny (1986). The results are shown in Table 2. The results, along with the above analysis (see Figure 1), suggest that psychological needs satisfaction fully mediates the impact of information assurance on perceived information control ( $\beta=.323$  vs  $.112$ ), and partially mediates the impact of information assurance on perceived benefit ( $\beta=.454$  vs  $.317$ ).

IV/MV	Model 1 (IV->MV)			Model 2 (IV->DV)		Model 3 (IV, MV->DV)	
	Autonomy	Competence	Relatedness	Info. control	Benefit	Info. control	Benefit
Assurance	0.314***	0.264***	0.649***	0.323***	0.454***	0.112 <sup>n.s.</sup>	0.317***
Autonomy	-	-	-	-	-	0.254***	0.188*
Competence	-	-	-	-	-	0.156*	0.092 <sup>n.s.</sup>
Relatedness	-	-	-	-	-	0.134 <sup>n.s.</sup>	0.083 <sup>n.s.</sup>
$R^2$	0.099	0.07	0.421	0.104	0.207	0.248	0.273

Note: IV – Independent variable, MV – Mediating variable, DV – Dependent variable;

\*  $p<.05$ , \*\*  $p<.01$ , \*\*\*  $p<.001$ , n.s.: non-significant.

**Table 2. Test of the mediating effect of needs satisfaction**

Similar test was conducted on the relationship between information assurance and behavioral intention. Without any intermediate variables, the direct effect of information assurance on intention was significant ( $\beta=.406$ ,  $p<.001$ ). With psychological needs satisfaction variables, the effect became less significant ( $\beta=.188$ ,  $p<.05$ ). With perceived information control variable added to the model, the effect further dropped, but marginally, to  $.176$  ( $p<.05$ ). All these suggest the mediating effect of psychological needs satisfaction on the relationship between information assurance and behavioral intention, which further justifies our purpose of studying online storage service adoption from the self-determination perspective.

## DISCUSSION AND CONCLUSIONS

Drawing upon the self-determination theory, we examined the impact of psychological needs satisfaction on the relationship between user information assurance (including technology-based assurance and institution-based assurance) and perceived information control, and between information assurance and perceived benefit. We found that information assurance indirectly influenced perceived information control and perceived benefits, as the effects were mediated by psychological needs satisfaction. Of the three components of needs satisfaction, perceived autonomy had the strongest impact in the model, followed by perceived relatedness. Perceived competence had impact on perceived information control only but not on perceived benefit. As such, this study addresses prior inconsistent findings regarding the roles of organizational mechanisms in dealing with information control issues, and offers a novel approach to similar research on user self-service on the cloud. Based on these findings, we suggest inclusion of the three basic psychological needs in related studies on individuals' volitional behavior in technology adoption and use.

### Implications

The study has a couple of theoretical implications. First, while past research have adopted various theoretical lens to examine the factors influencing perceived information control, the studies are largely anecdotal. This research is the first to adopt the SDT perspective to investigate the effects of psychological factors that enhance users' perceived control on personal information. This approach provides the means to other researchers to study information control in similar contexts.

Second, this study contributes to the understanding of a missing link regarding how users' information control can be enhanced. The extant research assumes the presence of information assurance measures will directly lead to the perceived information control. However, findings from empirical studies are mixed and inconsistent. Based on SDT, this study fills this gap by showing that the effect of information assurance measures on perceived information control relies on whether individual's innate psychological needs are satisfied.

The study also has implication for practice. Despite its claims of many benefits, cloud storage service was not widely adopted by end users.<sup>2</sup> This study suggests that to enhance perceived control and adoption of cloud storage, assurance mechanisms should be delivered in a way that supports the end users' needs for autonomy, competence, and relatedness. Of the three factors, autonomy is the most critical, suggesting that offering users choices in using cloud computing service would be ultimately important. This is followed by the role of perceived relatedness, suggesting that cloud computing service providers should develop a close relationship with the customers to alleviate their concerns about information privacy and security and enhance their perceived control. Interestingly, the impact of perceived competence on information control and benefit is the least important, questioning the limit of developing technological solutions to address privacy and security issues.

### Limitations

Several limitations should be addressed in future research. First, our study examined only one type of cloud computing service, but whether this model is applicable to other more complex cloud computing services should be further tested. Second, other than the technology-based and institution-based assurances, other organizational policies or practices such as sharing customer information with business partners may be examined for their impact on psychological needs, as those practices may hinder user information control and thus deter user adoption. Third, other non-organizational factors, such as industry self-regulations (Xu et al., 2011), may also influence a person's perceived information control, which should be examined in future research. Fourth, the three psychological needs were solely developed from the SDT perspective, while other fundamental needs may exist and could be incorporated in further research. For instance, the need for disclosure in social interactions (Li, 2014) may influence privacy and security perceptions. Fifth, the study should be replicated with non-student users to extend the generalizability. Finally, alternative approaches to information control, such as legislation and individual capabilities, may be studied in future research.

## REFERENCES

Available upon request.

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<sup>2</sup> <http://www.businessinsider.com/people-use-the-cloud-and-dont-even-realize-it-2014-7> (Accessed on April 6, 2017)