# A Study of Personal Cloud Computing: Compatibility, Social Influence, and Moderating Role of Perceived Familiarity

Murad Moqbel
*The University of Texas Rio Grande Valley*

Valerie L. Bartelt

Mohammed Al-Suqri

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# A Study of Personal Cloud Computing: Compatibility, Social Influence, and Moderating Role of Perceived Familiarity

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**Murad Moqbel**
University of Kansas Medical Center
mmoqbel@kumc.edu

**Valerie Bartelt**
Texas A&M University – Kingsville
Valerie.Bartelt@tamuk.edu

**Mohammed Al-Suqri**
Sultan Qaboos University
saqrim@squ.edu.om

## Abstract

Building on a research framework based on the Theory of Reasoned Action (TRA), Innovation Diffusion Technology (IDT), and the Technology Adoption Model (TAM), we propose a model integrating compatibility, social influence, and perceived familiarity given the implicit uncertainty of personal cloud. Our model emphasizes the moderating effect of perceived familiarity on the relationships between both perceived compatibility and social influence on behavioral intention. PLS-based structural equation modeling is employed to test the related propositions empirically. Results from a survey, involving 265 university students, reveal that perceived compatibility explains a larger proportion of the variance in behavioral intention; perceived familiarity plays a significant role in moderating the impact of perceived compatibility and social influence on intention to adopt personal cloud. Managerial and theoretical implications are discussed.

**KEYWORDS**: Compatibility, Familiarity, Social Influence, Moderating effects, interaction effects, Partial Least Squares.

## Introduction

The growth in use of personal cloud computing is one of the main recent developments in computing, which is increasingly accounting for a high proportion of Internet usage overall (Drago et al., 2013). Services such as Dropbox and GoogleDrive are rapidly growing in popularity among personal as well as organizational users. Benefits include the remote storage and processing of large amounts of private and shared information, which is synchronized with an individual's local computer folders and can be accessed from multiple devices.

There is a need to improve understanding of the factors that influence individual attitudes and likelihood to use personal cloud computing so that these can be addressed in the design and marketing of personal cloud services. This will help to improve the integrity and security of these services as well as helping to overcome unfounded concerns about these issues among potential users.

The study builds on previous research on technology adoption by using a theoretical framework based on the Theory of Reasoned Action (TRA) (Ajzen 1991; Ajzen and Fishbein 1980; Fishbein and Ajzen 1975), Innovation Diffusion Technology (IDT) (Rogers 1983),  and the Technology Adoption Model (TAM) (Davis et al. 1989).  This approach is based on the understanding that attitudes to use a technology influence intentions, which in turn are related to actual usage. Attitudes are influenced by factors identified by TAM such as perceived usefulness, ease of use, and enjoyment; factors identified by TRA such as social influence; and factors identified by IDT such as perceived compatibility. Previous researchers have also highlighted that intention to use technology is influenced by a wider range of

factors, and have emphasized the impact of moderating factors on the relationships between attitudes, intentions and usage.

More specifically, this research examines the adoption of personal cloud and aims 1) to identify whether perceived enjoyment, perceived ease of use, perceived usefulness, perceived compatibility and social influence are positively associated with behavioral intention to use personal cloud; 2) to explore the relationships between perceived compatibility and perceived usefulness, and 3) to examine the role of perceived familiarity with personal cloud as a moderating influence on the relationships between perceived compatibility and behavioral intention and between social influence and behavioral intention

## Literature Review

Cloud computing is rapidly accounting for a high proportion of Internet usage (Drago et al. 2013). This is a form of distributed computing, developed from the grid model (Qiong et al. 2013) in which a third party owns the technical infrastructure and delivers services to end users (Kuyoro et al. 2011). The US National Institute for Standards and Technology (NIST) has defined cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance 2011).

Within this form of technology, personal cloud computing is being very popular. Services include Dropbox, Google Drive and SkyDrive (Drago et al. 2013), which involve the remote storage of information on servers that are synchronized with users' local computer directories. An individual's personal cloud is defined as anything they can access on the cloud infrastructure, including private information to which others have no access, as well as information shared between individuals such as co-workers or friends (Andersen and Karlsen 2011). The documented benefits of cloud computing services include enhanced processing and storage capacity, resilience, flexibility and efficiency (Kuyoro et al. 2011; Qiong et al. 2013).

Models of technology acceptance provide useful frameworks for examining factors that influence attitudes towards personal cloud computing and the ways that these relate to actual usage of the technology. A number of quantitative studies have taken this approach, with a view to identifying the critical factors that can be addressed in the design and marketing of cloud computing services. Most of the research in this area has been based on the Theory of Reasoned Action (TRA) (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975). This theory explains that attitudes towards performing a behavior are positively associated with intentions to perform that behavior and predict their actual behavior, and that attitudes are influenced by "social influence" or social pressures. The attitudes of others towards a particular technology often influence the intentions of an individual to use this technology, for example when an individual's relatives or friends often persuade them to join social networks (Ellison et al. 2007).

Davis et al. (1989) expanded on the TRA to develop the Technology Acceptance Model (TAM), in which "perceived usefulness" and "perceived ease of use" were identified as the two main factors influencing attitudes towards using a particular technology. The significance of these variables was confirmed in empirical research by Wu, Lan, and Lee (2013). Using this basic theoretical model, other researchers have incorporated additional variables to investigate the influence of various personal and organizational factors on likelihood of use (Alharbi 2012).

Overall there is a significant body of research, based on the Theory of Reasoned Action and the Technology Adoption Model, into the factors influencing individual attitudes towards technology and into the relationships between these attitudes, intentions to use the technology and actual usage. However, there have been relatively few empirical studies into the factors affecting attitudes to and usage of personal cloud computing services in particular. Researchers have identified the need for more sophisticated studies of individual level technology usage (Venkatesh et al. 2012) in general and more recently in relation to personal cloud computing (e.g. Sun & Zhang, 2005).

# Hypotheses Development

## *Perceived Enjoyment and Personal Cloud Computing*

Perceived enjoyment can be related to cognitive dissonance theory (Festinger 1957). A person intrinsically prefers to be in a positive state of harmony, experiencing little internal conflict, or negative feelings (Festinger 1957). Cognitive dissonance theory can be related to perceived enjoyment and behavioral intentions. Positive or negative associations of the technology may be an indicator to whether a person intends to use personal cloud computing. A logical conclusion can be drawn that a person will more likely use the technology if they are experiencing positive feelings, such as enjoyment, towards it. Thus, we hypothesize that perceived enjoyment will affect whether a person will intend to use personal cloud computing.

**H1**: *Perceived enjoyment is positively associated with behavioral intention to use personal cloud computing.*

## *TAM and Personal Cloud Computing*

Personal cloud computing is an information technology. This paper proposes that it has similar patterns of use as delineated by the technology acceptance model (TAM) (Davis 1989; Davis et al. 1989). TAM offers a model of behaviors for IT use (Gefen et al. 2003; Gefen and Straub 2000) in both the organization and outside of the organization (Agarwal and Karahanna 2000; Davis et al. 1989; Gefen and Straub 2000; Mathieson 1991). TAM is governed by the belief that perceived usefulness (PU) and perceived ease of use (PEOU) affects the intention to use the information technology (Gefen and Straub 2000; Venkatesh and Davis 2000). Similarly, we believe that a similar model will relate to personal cloud computing. Perceived ease of use will affect the intention to use personal cloud computing (H2) and that perceived usefulness will affect the intention to use personal cloud computing (H4). Additionally, perceived ease of use will positively affect perceived usefulness (H3).

**H2**: *Perceived ease of use is positively associated with behavioral intention to use personal cloud.*

**H3**: *Perceived ease of use is positively associated with perceived usefulness.*

**H4**: *Perceived usefulness is positively associated with behavioral intention to use personal cloud.*

## *Perceived Compatibility and Personal Cloud Computing*

Compatibility is the level of consistency of the particular innovation with the users' values, experiences, and needs (Moore and Benbasat 1991; Sonnenwald et al. 2003). Perceived compatibility's association with perceived usefulness can best be explained by cognitive dissonance theory. Cognitive dissonance theory states that a person is more likely to gravitate towards a situation that is harmonious versus a situation that causes inner conflict (Festinger 1957). Thus, if an information technology is more similar to a person's lifestyle then he/she would experience greater compatibility feelings, leading to perceptions that the technology is useful. Similarly, a person would be more likely to consider using personal cloud computing if it is perceived to be compatible to his/her lifestyle.

**H5**: *Perceived compatibility is positively associated with perceived usefulness.*

**H6**: *Perceived compatibility is positively associated with behavioral intention to use personal cloud.*

## *Social Influence and Personal Cloud Computing*

Subjective norm (hereafter referred to as social influence) is the degree to which others, who are important to a person, affect his/her behavior (Fishbein and Ajzen 1975; Venkatesh and Morris 2000a). Both peers and those in authority have been found to affect social influence (Mathieson 1991; Taylor and Todd 1997; Venkatesh and Morris 2000a). The Theory of Planned Behavior found that a person's social group behavior toward a technology affects behavioral intention (Dinev et al. 2006). Additionally, the

TRA found social influence and attitude towards the behavior to affect behavioral intention (Ajzen and Fishbein 1980; Chan and Lu 2004; Fishbein and Ajzen 1975). We believe that social influence will play a similar role in personal cloud computing. We hypothesize that influences from others will be a factor in the intention to use personal cloud.

**H7**: *Social influence is positively associated with behavioral intention to use personal cloud.*

### Innovation Diffusion Technology Model and Familiarity

The innovation diffusion technology model is a theory proposed by Rogers (1983) and often used in IS research (Karahanna et al. 1999; Taylor and Todd 1997). Innovation diffusion describes how channels are used to relay the innovation over time (Agarwal and Prasad 1998; Wu and Wang 2005).  Perceived compatibility is one characteristic of the innovation diffusion model that explains user adoption (Wu and Wang 2005). We believe that a person who perceives cloud computing as compatible will experience increased behavioral intentions.

Familiarity involves experience with some process of a particular situation (Gefen et al. 2003). Familiarity reduces uncertainty due to increased insights into the present situation (Gefen 2000; Gefen et al. 2003; Luhmann 1979). It is possible that increased familiarity with cloud computing will increase people's positive associations. We hypothesize that perceived familiarity with personal cloud computing will enhance the effect of perceived compatibility on behavioral intentions.

**H8**: *Perceived familiarity with personal cloud will moderate the effect of perceived compatibility on behavioral intention, such that the effect will be stronger for users with high familiarity.*

The premise of familiarity lies in understanding the present situation. Familiarity serves as a precursor to trust, which is essential in social interactions and decision making (Gefen et al. 2000; Luhmann 1979). This paper believes that users with a low level of familiarity with cloud computing will resort to others' opinion for making the decision to use the technology because their opinion at this stage is "ill-informed" (Venkatesh et al. 2003). According to the unified theory of acceptance and use of technology (UTAUT), social influence will diminish over time as individuals gain more experience with the technology (Venkatesh et al. 2003); however, we believe that social influence is a necessary ingredient for the present situation that causes people to use cloud computing. We hypothesize that social influence will increase the effect of behavioral intentions in situations where users have lower familiarity with personal cloud computing.

**H9**: *Perceived familiarity personal cloud will moderate the effect of social influence of behavioral intention, such that the effect will be stronger for users with low familiarity.*

## Research Methodology

We used the survey method to examine our model. We constructively tested the nine hypotheses with a sample of college students from two universities in southwest Texas.

The proposed model was tested using extant validated scales that were adopted from previous literature. A multi-indicator scale developed by Gefen et al. (2003) was adapted to measure the *perceived familiarity* of using personal cloud computing. *Perceived ease of use and perceived compatibility* were measured with scales from Wu and Wang (2005). *Perceived usefulness* and perceived compatibility were adapted from Venkatesh and Morris (2000b). The *intention to use* latent variable scale was adopted from Agarwal and Karahanna (2000) and Davis et al. (1992).

All latent variables in the research instrument used seven-point Likert scale ranging from 1 = strongly disagree, 2 = moderately disagree, 3 = slightly disagree, 4 = neutral, 5 = slightly agree, 6 = moderately agree, to 7 = strongly agree.

A total of 265 completed questionnaires were obtained from students from two universities in southwest Texas. Females contributed 52.1% of the responses. The average age of the respondents was 23.8 years, with a standard deviation of 8.70 years. The majority of respondents were Hispanic (67%), followed by white (30%), and other (3%). In terms of educational level, 20% of the respondents had only completed

high school, 20.4% had a 2-year college degree, 55% had a 4-year college degree, 4.5% had a master's degree, and 1.9% had a doctoral degree. In terms of employment status, 22.3% of the respondents were employed full time, 52.5% were employed on a part-time basis, and 27.2% were unemployed. The average work experience was 5.5 years. Control variables included gender, race, educational level, and age in years.

### *Validation of the Measurement Instrument*

The structural and measurement models were tested using structural equation modeling. Partial least squares- based (PLS) structural equation modeling approach was employed to evaluate the psychometric properties of the instrument and to test the research hypotheses in this study (Chin 1998b) (Haenlein and Kaplan 2004; Kock 2010). The WarpPLS software package (version 4.0) (Kock 2010)was used to generate the estimations for validation of the measurement instrument, confirmatory factor analysis, and the structural equation modeling analysis.

We first assessed convergent validity of the measurement model. To ensure individual item convergent validity, we examined factor loadings of each measure on its underlying construct. All of the individual items loadings exceeded the recommended minimum of 0.7 and significant at 0<.05 (Chin 1998a), indicating that the latent variable measures have acceptable convergent validity.

To confirm the scale internal consistency and reliability of the latent variables, we calculated the composite reliability (Fornell and Larcker 1981). All measures have composite reliability values greater than the recommended level of 0.7 (Bagozzi and Yi 1988). In addition to composite reliability, Cronbach's alpha values were calculated, exceeding the recommended threshold of 0.7 (Nunnally and Bernstein 1994).

To confirm the discriminant validity of latent variables in the proposed model, the square root of the average variance extracted (AVE) for each latent variable was compared with the correlation scores of the other latent variables in the correlation matrix. AVEs for each latent variable surpassed the correlations between the latent variable and other latent variables as shown in Table 1, in support of discriminant validity (Gefen et al. 2000). The results indicate that the latent variable measures have acceptable discriminant validity (Fornell and Larcker 1981).

|       | COM      | RNJ      | PEU      | PU       | INT      | SOC      | FAM      |
|-------|----------|----------|----------|----------|----------|----------|----------|
| COM   | (0.930)  |          |          |          |          |          |          |
| RNJ   | 0.577    | (0.922)  |          |          |          |          |          |
| PEU   | 0.544    | 0.455    | (0.933)  |          |          |          |          |
| PU    | 0.574    | 0.655    | 0.635    | (0.938)  |          |          |          |
| INT   | 0.703    | 0.68     | 0.579    | 0.692    | (0.929)  |          |          |
| SOC   | 0.235    | 0.497    | 0.157    | 0.372    | 0.407    | (0.922)  |          |
| FAM   | 0.658    | 0.331    | 0.635    | 0.488    | 0.53     | 0.118    | (0.875)  |

**Table 1. Latent Variable Correlations and Square Roots of Average Variances Extracted**

Notes: COM = perceived compatibility; FAM = perceived familiarity; ENJ = perceived enjoyment; PEU = perceived ease of use; PU = perceived usefulness; INT = intention to use; SOC = social influence.

# Results

Figure 1 depicts the results of the model estimation—standardized path coefficients and their significance—and variances explained by exogenous variables ($R^2$).The findings show that all nine proposed hypotheses were supported. Perceived enjoyment (H1) ($\beta$=.21, p <0.001) had a significant effect on behavioral intention to use personal cloud computing. Perceived ease of use (H2) ($\beta$=.12, p <0.05) did not only have a significant effect on behavioral intention, but also (H3) ($\beta$=.46, p <0.001) had a significant effect on perceived usefulness, explaining 48% of the perceived usefulness variance along with perceived compatibility. Perceived usefulness (H4) ($\beta$ =.21, p <0.001) had significant effect on behavioral intention as well. Perceived compatibility (H5) ($\beta$=.33, p <0.001) had significant effects on perceived usefulness and on behavioral intention (H6) ($\beta$=.34, p <0.001). Social influence had a significant effect on behavioral intention (H7) ($\beta$=.19, p <0.001).

The last two hypotheses relate to the moderated effects of perceived compatibility and social influence on behavioral intention. H8, which predicted that perceived familiarity will moderate the effect of perceived compatibility on behavioral intention, was supported ($\beta$=.16, p <0.01). This result indicates that perceived compatibility is more important for familiar users of personal cloud. H9, which predicted that perceived familiarity with personal cloud will moderate the effect of social influence on behavioral intention such that the effect will be stronger for users with low familiarity, was supported ($\beta$=-.14, p <0.01). Our proposed model including the interaction terms explained 70% of the variance in behavioral intention. None of the control variables was significant.
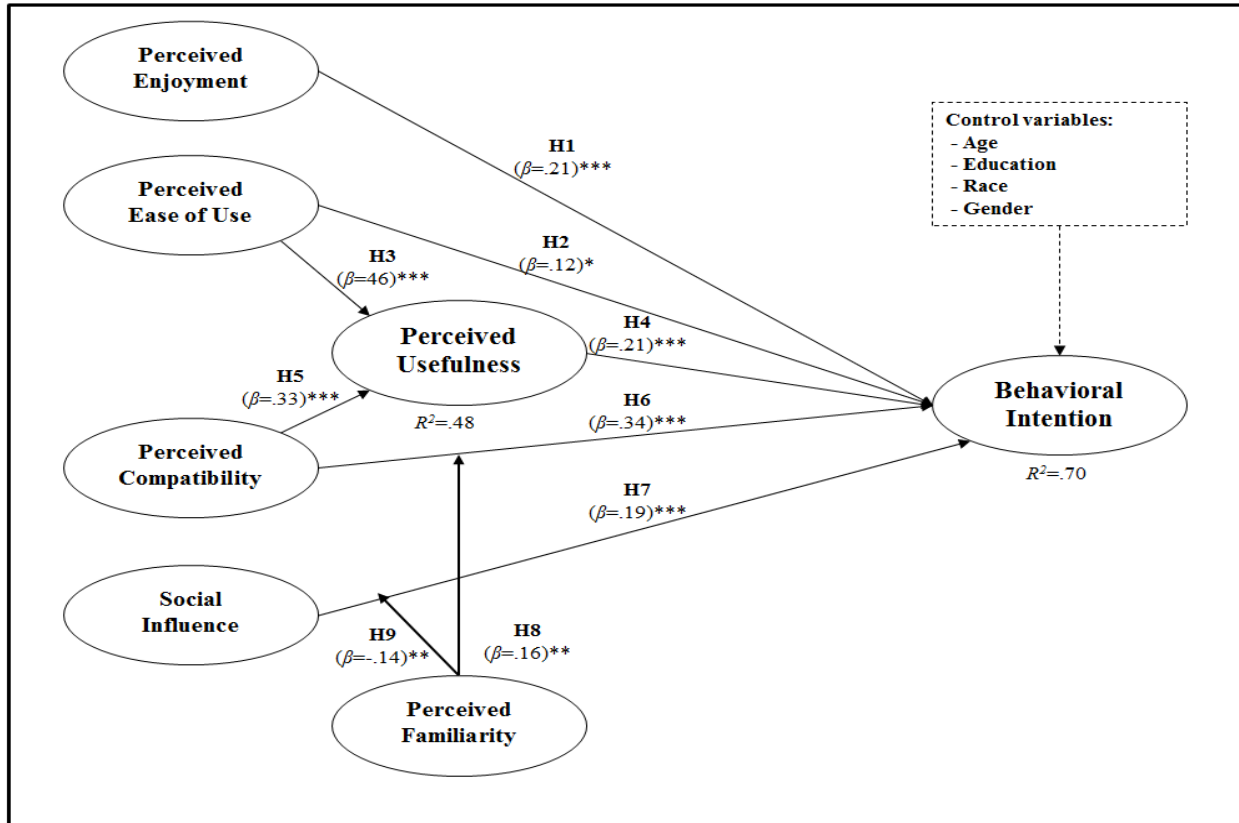


**Figure 1. Model with results for direct effects and related hypotheses**
Notes: * P<0.05; ** P<0.01; *** P<0.001.

## Discussion

This paper found a variety of attitudes affecting the behavioral intentions of personal cloud computing using a theoretical framework of the TRA, IDT, and TAM. This study was based on three primary concerns: 1) personal attitudes, 2) social influence, and 4) the moderator role of perceived familiarity on perceived usefulness and behavioral intentions. Some personal attitudes hypothesized included perceived ease of use, perceived usefulness, perceived enjoyment, and perceived compatibility affect behavioral intentions. We also hypothesized that perceived compatibility would affect perceived usefulness. Also, perceived ease of use was hypothesized to be associated with perceived usefulness. Social influence was hypothesized to affect behavioral intentions. Finally, perceived familiarity was hypothesized to moderate the relationship of perceived compatibility on behavioral intentions as well as social influence on behavioral intentions. We hypothesized that it would strengthen the relationship between perceived compatibility and behavioral intentions. We also hypothesized that the effect on social influence on behavioral intentions would be stronger when perceived familiarity is low. We found all of these hypotheses to be supported.

Consistent with our expectations, H 8 was supported. Personal cloud users indeed gravitate toward the use of personal cloud because this technology is similar to their lifestyle and fits well with the way they like to do their work and the effect increases with the level of familiarity as users discover more usages that match their daily work style.

Figure 2 shows how the relationship between perceived compatibility and behavioral intention looks stronger for users with high level of familiarity than for users with low level of familiarity.
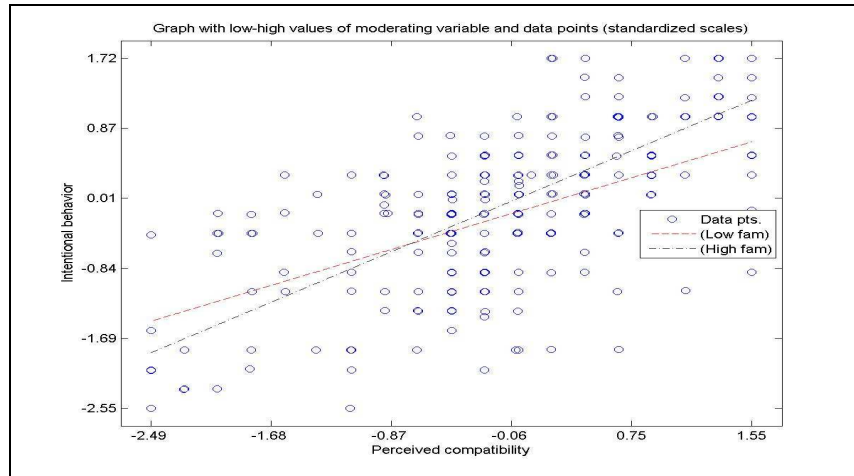


**Figure 2. The moderating effect of perceived familiarity on COMP → INT**
Notes:   - Vertical axes: *Behavioral intention*; horizontal axes: *Perceived compatibility*
- The axes scales are unstandardized

As we predicted, H 9 was supported. Indeed, perceived familiarity with personal cloud computing increased the effect of social influence on behavioral intentions for users with low levels of familiarity with personal cloud. Users with low level of familiarity with personal cloud rely on their peers and superiors for making the decision to adopt the technology because their opinion at this stage is still "ill-informed" (Venkatesh et al. 2003). Figure 3 shows the graph relating to the moderating effect perceived familiarity has on the relationship between social influence and behavioral intention.
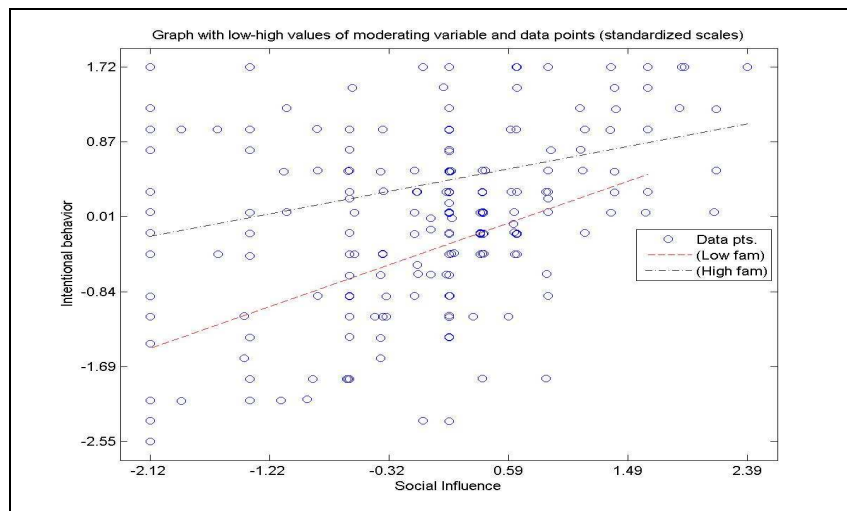


**Figure 3. The moderating effect of perceived familiarity SI → INT**
Notes:
- Vertical axes: *Behavioral intention*; horizontal axes: *Social influence*
- The axes scales are unstandardized

### Limitation

One of the limitations of this study is that it is based on data collected from students. However, recent studies found no difference in the relationships between variables when using student-recruited vs. non-student-recruited samples, concluding that student-recruited samples lead to similar practical and statistical conclusions (Steelman et al. Forthcoming; Wheeler et al. 2014). Students, future workforce, tend to use this technology now and most likely to carry on this habit to the workplace.

### Implications

Perceived enjoyment affecting behavioral intentions is an interesting hypothesis. If a person finds personal cloud computing enjoyable, then their intentions to use personal cloud computing will increase. This suggests that managers should find ways to make personal cloud computing enjoyable, if they are interested in increasing behavioral intentions to use cloud computing.

Perceived compatibility should also be fostered in businesses in order to increase perceived usefulness and behavioral intentions of personal cloud computing. Personal cloud computing should be introduced as a tool that enhances present work functions, and not as a radical new technology that lacks a relevant business application. Thus, managers should introduce personal cloud computing by providing examples of how it is similar to employees' current workflow.

The extent of users' awareness or familiarity with the technology is a prerequisite for deciding whether it is relevant to their life styles and current needs (Rogers 2010). Examining perceived familiarity in this context is not only important for theory but also for practice as it can suggest that more awareness and campaigns are important for businesses to conduct in order to facilitate the technology adoption decision.

A possibility for incorporating perceived familiarity involves highlighting personal cloud computing's similarity to the tools individuals are currently using. It is possible that there are overlaps of certain features with technologies currently in place. For instance, the folder structure and drag/drop capabilities of personal cloud computing may be similar to the structure and drag/drop capabilities of their flash drive.

Since social influence affects behavioral intentions, managers should choose employees to introduce personal cloud computing who are in a lateral capacity as those who are involved in the training session. One way to do this would be to include testimonials by colleagues.

This study contributes to theory by improving understanding of technology usage, specifically relating to personal cloud computing, and provides the opportunity to develop new or refined models of technology use that reflect the most recent developments in personal use of computing technology. This research is, to the best of our knowledge, the first to investigate the moderating role of perceived familiarity on the relationships between social influence and behavioral intention and perceived compatibility and behavioral intention. These factors are related to cognitive dissonance theory.

## Conclusion

This paper examined the antecedents of behavioral intention on personal cloud computing. Similar to the technology adoption model (TAM) and the Theory of Reasoned Action (TRA), perceived ease of use and perceived usefulness were found to positively affect behavioral intention. Perceived ease of use was also found to affect perceived usefulness. In addition, positive emotions of perceived enjoyment affected behavioral intentions. Less conflicted experiences due to perceiving compatibility towards personal cloud computing affected perceived usefulness and behavioral intentions. Social influence from others also affected behavioral intentions. Finally, perceived familiarity served as a moderator of perceived compatibility and behavioral intentions (greater perceived familiarity increased this effect) and social influence and behavioral intentions (less perceived familiarity increased this effect). This paper highlights the importance of using testimonials and colleagues when introducing personal cloud computing, due to the effect of social influence on behavioral intentions. Also, introducing personal cloud computing as a way to enhance employees' current workflow is recommended to increase behavioral intentions. Finally,

managers should consider training employees in a variety of basic computer skills to increase their abilities to associate prior skills with new technologies, such as personal cloud computing.

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