Examining the Role of Privacy in Virtual Migration: The Case of WhatsApp and Threema

Full paper

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Abstract

WhatsApp is a widely used instant messaging application on smartphones. However, owing to privacy deficiencies in WhatsApp, alternative services that emphasize privacy protection, such as Threema, have emerged. Thus, the question arises whether users would switch from WhatsApp to Threema for privacy reasons, and what the factors are that would affect their switching intention. To answer these questions, we develop a research model examining the role of privacy in virtual migration, using the push-pull-mooring (PPM) migration framework as a theoretical lens. Based on the results of an online survey of 220 German-speaking smartphone users, we found that privacy protection is relevant to users' switching intention in two ways: as a push effect encouraging users to leave WhatsApp, and as a pull effect attracting users to Threema. However, while our results suggest that peer influence facilitates WhatsApp users' switching intention, switching costs appear to be a strong barrier.

Keywords

Privacy protection, messaging applications, service switching, push-pull-mooring framework.

Introduction

In recent years, privacy has increasingly become a determining factor in consumers' use of internet services. Various popular service providers, like Facebook and Google, have specifically attracted negative public attention for admitting that they collect, store, and analyze personal information on their users. Security agencies' interception of internet services has also affected the social debate on governmental surveillance, as well as on the security and integrity of personal data. Consequently, the commercial (e.g. Hong and Thong 2013) and governmental (e.g. Dinev et al. 2008) utilization of personal information may lead to ordinary users' privacy concerns when using internet services. Many previous studies, particularly in the Information Systems field, have shown that privacy concerns impact users' intentions to disclose and share personal information, to conduct e-commerce transactions, to adopt personalized and location-based internet services, and to protect their privacy (for an overview, see Li 2011 and Smith et al. 2011). However, prior research has focused less on the question of whether users would abandon a currently used internet service and switch to another provider for privacy reasons. In this study, we aim to close this gap by looking at the actual and topical case of WhatsApp and Threema.

WhatsApp (www.whatsapp.com) is a widely used instant messaging application on smartphones. The service allows individuals, as well as groups, to send and receive free real-time text and multimedia messages online. However, while using WhatsApp offers benefits in terms of communications costs, as well as conveying a sense of community and immediacy (Church and de Oliveira 2013), experts raised serious privacy and data protection issues. The absence of an adequate encryption technology was specifically seen as a risk to users' privacy, as others could gain access to private messages. Although WhatsApp has recently implemented an end-to-end encryption technology for its Android version, experts still question WhatsApp's privacy protection, due to, for example, its linkage between phone

numbers and messenger accounts and the opportunity to identify daily routines, or conversation partners, through users' online status (Buchenscheit et al. 2014; Schrittwieser et al. 2012). Moreover, especially Facebook's acquisition of WhatsApp raised privacy concerns due to users' fear that Facebook might combine their personal information on both services, or exploit their private WhatsApp messages. Consequently, more privacy-friendly messengers have emerged. Threema (https://threema.ch) is such an alternative service and is primarily popular in German-speaking countries. This Swiss instant messaging application pays special attention to privacy protection, and guarantees, without exception, real asymmetric end-to-end encryption of text and multimedia messages for individual and group chats. Moreover, the service does not require a linkage between Threema identities and phone numbers, while providing a feature to verify contacts' identity. To summarize, while both messaging applications are basically very similar in function, they differ regarding the protection of their users' privacy.

Taking this into account, the question arises whether users would switch from WhatsApp to Threema for privacy reasons, and what the factors are that would affect their switching intention. In order to answer these questions, we develop a research model examining the role of privacy in virtual migration, using the push-pull-mooring (PPM) migration framework as a theoretical lens. Subsequently, we conduct an online survey to test our research model and hypotheses.

The paper is structured as follows: The next section discusses the PPM's applicability as a theoretical framework in the context of service provider switching, and explains the research model and hypotheses development. We next describe the research design and data collection. Thereafter, the data analysis and results are presented. We conclude with an overall summary of the study and a discussion of its implications and limitations.

Theoretical Background

The Push-Pull-Mooring Migration Framework

Originally derived from human migration research, the PPM migration framework has a long history dating back to Ravenstein's (1885) laws of migration. The concept explains human migration, which means individuals' movement between two places for a certain period of time (Boyle et al. 1998), by means of push, pull, and mooring factors. The push factors are the place of origin's negative aspects, which encourage individuals to leave, while the pull factors refer to the destination's positive attributes, which attract people (Lee 1966). In contrast, mooring factors, such as personal and social factors, moving costs, etc., can either inhibit or encourage human migration (Bansal et al. 2005; Lee 1966). During the last decade, the PPM migration framework was also applied to consumers' service switching behaviors. Bansal et al. (2005) were the first to apply the PPM in this context. They proved the PPM's relevance as a unifying theoretical framework for understanding why consumers switch their service providers, or don't. Thus, a few studies focusing on internet services have applied the PPM to examine virtual migration.

For instance, Hou et al. (2011) use the PPM to explain online gamers' switching intentions in terms of "migrating to a new virtual world." Their results indicate that the mooring effect affects players' switching intention more strongly than the pull effect, while the push effect had no significant influence. In another empirical study, Bhattacherjee and Park (2014) use the PPM to investigate why end-users migrate from client-hosted computing to cloud computing, using Google Apps as an example. Examining the case of blog service providers, Zhang et al. (2012) show that bloggers' satisfaction with their current blog, as well as their sunk costs, influences their switching intention negatively, while the attractiveness of alternative blog services has a positive impact. Additionally, Hsieh et al. (2012) investigate post-adoption switching behavior regarding online service substitutes, using blogs and social networking sites (SNS) as examples. Their results demonstrate that "perceptions of weak connections and writing anxiety push bloggers away, whereas relative enjoyment and usefulness pull bloggers to social network sites; switching cost and past experience also inhibit a change." In a recent study, Chang et al. (2014) examine the push, pull, and mooring effects on SNS users' virtual migration. They identify dissatisfaction and regret as push factors, alternative attractiveness as a pull factor, and the switching costs as a mooring factor affecting SNS users' switching intention. Moreover, they find that both the pull and mooring factors have strong moderation effects. In another study on SNS switching, Xu et al. (2014) examine the role dissatisfaction with the current SNS (push factor), attraction from an alternative SNS (pull factor), as well as switching costs and peer influence (mooring factors), play in SNS users' switching intention. They simultaneously emphasize

the various dimensions of dissatisfaction. Their results "reveal four significant factors that promote switching: dissatisfaction with socialization support, dissatisfaction with entertainment value, continuity cost, and peer influence."

To summarize, while the PPM's suitability in the context of internet service switching is proven, previous work has to date neither looked into the switching of smartphone messaging applications, nor specifically focused on the role of privacy in virtual migration. Instead, a closer look at prior research reveals that only two studies have considered privacy-related aspects in their PPM models: Bhattacherjee and Park (2014), by including security concerns as a mooring factor, and Xu et al. (2014), by applying dissatisfaction with member policy as one of five dissatisfaction dimensions. We therefore had to develop a new PPM-based model that would allow us to fulfill this study's objective.

Research Model and Hypotheses Development

Owing to its successful application in prior research, we use the PPM migration framework to develop a research model with which to examine the role of privacy in virtual migration. Within the special context of WhatsApp and Threema, privacy is relevant with respect to both the push and the pull factor: on the one hand, dissatisfaction with privacy protection might drive users away from WhatsApp. On the other hand, Threema might attract users by providing better privacy protection than WhatsApp. By considering privacy in this double role, we follow the literature that suggests that push and pull factors are generally symmetrical (Xu et al. 2014). Since we specifically focus on the role of privacy and because we assume that WhatsApp and Threema are very similar concerning their usability and functionality, we apply no other push and pull factors, thus keeping the model as simple as possible. Nevertheless, we have to consider three special aspects when examining the case of WhatsApp and Threema: first, comparable with using SNS, the use of messaging applications includes a social component by conveying a sense of community and connection (Church and de Oliveira 2013), and the utility that users derive from using a certain messenger increases with the number of their friends using the same service. Thus, SNS, as well as messaging applications, are subject to network effects (see Katz and Shapiro 1985). Taking this into account, we follow Xu et al. (2014) and not only consider the switching costs, but also peer influence as separate and conceptually distinct mooring factors. Next, while prior research has usually dealt with free internet services (e.g. SNS or blogs), switching from WhatsApp to Threema involves monetary costs. We thus include the financial cost, in addition to the continuity cost and the setup cost, as the switching costs' dimensions. Finally, given that switching messengers does not imply completely terminating the former service's use, we understand switching as a usage-level shift from WhatsApp to Threema (see Xu et al. 2014). Figure 1 illustrates the research model.

Push Factor

Previous research on virtual migration has frequently applied dissatisfaction (or satisfaction) with the current service as the push factor in PPM-based models (e.g. Bhattacherjee and Park 2014; Chang et al. 2014; Xu et al. 2014; Zhang et al. 2012). However, since we are specifically interested in the role of privacy, we do not focus on users' general dissatisfaction with WhatsApp. Instead, we explicitly emphasize dissatisfaction with privacy protection, suggesting that the higher users' dissatisfaction with the protection of their privacy in WhatsApp, the higher their intention to switch to Threema. Thus, we hypothesize:

H1. Dissatisfaction with privacy protection is positively related to users' switching intention.

Pull Factor

In the context of virtual migration, pull factors refer to an alternative service's positive attributes that attract users. However, in prior studies, the conceptualization of the pull factors has differed, inter alia, depending on the research object's level of abstraction. Studies that do not focus on switching between specific services usually refer to the attraction of any alternative services as the pull factor (e.g. Chang et al. 2014; Xu et al. 2014). In contrast, prior studies focusing on a specific case have conceptualized the pull factor as the concrete alternative service's relative advantage when compared to the current service. For instance, Bhattacherjee and Park (2014) examine the push effect of cloud-computing's relative usefulness versus client-based computing. Moreover, Hsieh et al. (2012) consider the relative enjoyment, relative

ease of use, and relative usefulness of Facebook compared with blogs as the pull effect's dimensions. Due to looking at WhatsApp and Threema as a concrete case, we follow this approach, and conceptualize the pull factor as Threema's relative advantage compared with WhatsApp. However, since we thereby refer exclusively to privacy protection, we call this construct relative privacy protection. We thus hypothesize:

H2. Relative privacy protection is positively related to users' switching intention.

Mooring Factors

In the literature on virtual migration, switching costs are found to be a significant mooring factor, discouraging users from switching their service provider even if the push and pull factors are strong (Bansal et al. 2005). Prior work has looked into and identified various types and switching costs dimensions (see Burnham et al. 2003; Jones et al. 2002; Ray et al. 2012). In a nutshell, switching costs "include the economic, psychological, and emotional sacrifices that may be necessary before, during, and after service conversion" (Kim et al. 2006). Taking previous research into account, three switching costs dimensions are relevant in terms of WhatsApp and Threema: first, when switching from WhatsApp to Threema, users have to notify their WhatsApp contacts and build a new contact network in Threema. This effort can be understood as the continuity cost (see Chang et al. 2014 and Xu et al. 2014). Next, users have to spend additional time and effort in signing up to Threema, and in downloading, installing, and setting up the application, which is the setup cost (see Burnham et al. 2003). Finally, since Threema charges a one-time fee of between EUR 1.60 and EUR 1.99, depending on the operating system, we have need to consider the financial cost (Burnham et al. 2003). We therefore conceptualize the switching costs as a higher-order construct, which includes the continuity, setup, and financial cost. We thus hypothesize:

H3. Switching costs are negatively related to users' switching intention.

Consumers use WhatsApp to primarily communicate with their (close) friends and family, thereby experiencing a sense of community and connection (Church and de Oliveira 2013). Hence, the use of messaging applications includes a social component. Taking social influences into account, prior research has seen an unfavorable subjective norm toward switching as a mooring factor that encourages users to stay with their current service (e.g. Bansal et al. 2005). However, users are also expected to use the same service as their personal network to stay in contact with their friends. We thus follow Xu et al. (2014) and assume that the peer influence of contacts who prefer Threema encourages WhatsApp users to switch:

H4. Peer influence is positively related to users' switching intention.

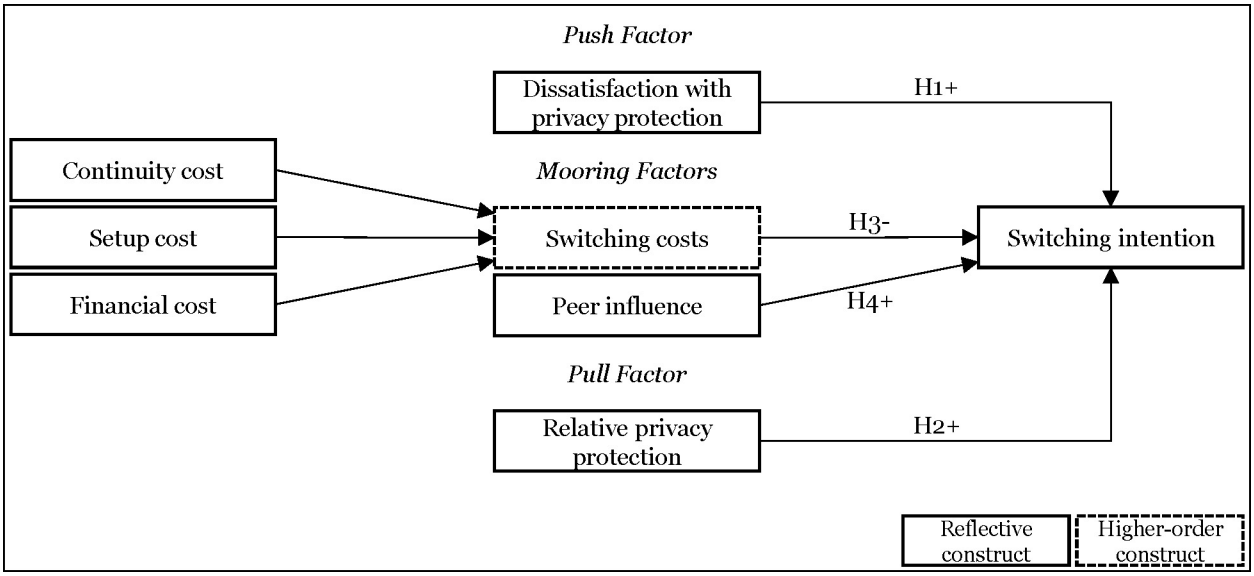

Figure 1. Research Model

Research Design and Data Collection

Comparing WhatsApp and Threema

In order to test our research hypotheses, we developed an online survey consisting of two major parts. The first part was a comparison of WhatsApp and Threema, providing relevant facts and revealing the differences between the messaging applications and their similarities. When starting the survey, the participants were asked to carefully examine this comparison. We thus ensured that the participants had adequate knowledge about WhatsApp and Threema, which is necessary when examining users' switching intention. Given that Threema is generally less widely used than WhatsApp, this is even more important. We compared WhatsApp and Threema based on recently published technical articles (e.g. Belschner 2014) to ensure the information was correct and current. However, to facilitate a comparison of the messaging applications, we presented the relevant facts in tabular form. We further divided the comparison into four sections presented on separate pages in the survey.

First, we compared WhatsApp and Threema with regard to their diffusion and availability. In short, it was shown that WhatsApp is much more widely used, while Threema is especially popular in the German-speaking countries. Further, both applications are available for most operating systems. In addition, the comparison revealed only negligible differences between the messaging applications' usability and functionality. We subsequent compared WhatsApp and Threema regarding their privacy protection. In brief, the messaging applications differ with regard to their encryption of contents and communications data, their server location, and the associated data protection law. Thus, although WhatsApp improved its privacy protection in recent months, Threema pays even more attention to the protection of user privacy. Finally, we compared the applications in terms of their price and advertisement. While WhatsApp and Threema do not advertise, they differ in their payment model. At the moment, new users can use WhatsApp free of charge for a year. After that, the messaging application costs EUR 0.89 per year. However, current users may not have to pay an annual price due to WhatsApp's different pricing model in the past. Depending on the operating system, Threema costs a one-time sum of between EUR 1.60 and EUR 1.99. In sum, comparing WhatsApp and Threema revealed that both applications are very similar with the exception of their diffusion and privacy protection.

Scale Development

The second part of the survey comprised the questionnaire containing a number of items measuring the constructs specified in the research model (see Appendix). The scales were primarily adopted from Xu et al. (2014) and modified to fit our research context. We developed the financial cost by adopting appropriate items from the economic risk costs and the monetary loss costs provided by Burnham et al. (2003), and developed the relative privacy protection on the basis of Bhattacherjee and Park's (2014) relative usefulness scale. A multidimensional higher-order construct comprising the three distinct dimensions continuity cost, setup cost, and financial cost represent the switching costs (SW). Since its dimensions do not share a common cause, but rather form a general concept, we modeled switching costs as a second-order formative construct constituted by three reflectively measured first-order constructs (reflective-formative type II model) (Becker et al. 2012). Apart from switching costs, all the other constructs are reflectively measured constructs operationalized as seven-point Likert scale items. The continuity cost, setup cost, financial cost, relative privacy protection, peer influence, and switching intention range from 1 (strongly disagree) to 7 (strongly agree); dissatisfaction with privacy protection ranges from 1 (extremely satisfied) to 7 (extremely dissatisfied). All the items were translated into German and verified by native speakers.

Survey Administration and Sample

We collected data by means of an open, web-based survey of German-speaking smartphone users. Since we intended to examine WhatsApp users' switching intentions, we screened for participants who used WhatsApp as their primary messaging application at the time of the survey. Furthermore, we only chose participants who had never used Threema for this study. We thus ensured that we observed the participants' switching intentions, instead of their previous behaviors, and avoided their experiences with Threema biasing their answers. Moreover, since Threema is only available for iPhones, Android, and

Windows Phone, we excluded all those participants who did not have a suitable operating system, or did not generally download and install new applications. By implementing a filter at the start of the questionnaire, we ensured that only persons who fulfilled all the conditions participated in the survey.

We invited people to participate in the survey via Facebook as well as via e-mail using the university's mailing list. The survey was placed online from January 30 to February 4, 2015, and provided a total of 251 fully completed responses. In order to prepare the sample for analysis, we adjusted for respondents who had spent less than five minutes on answering the questionnaire, owing to concerns about their thoroughness and their answers' quality. This led to a dataset of 220 suitable responses. The participants were on average 24.5 years old, and most of them held a high school or college degree (97%), which is typical of a student sample. The ratio of female and male respondents was approximately 2:1. However, the sample distribution was satisfactory with regard to this study's aim.

Data Analysis and Results

We used structural equation modeling to analyze the data and test our hypotheses. Therefore, the statistical software SmartPLS 3.1.9, which employs the partial least squares (PLS) algorithm, was applied for all the analyses. Since iterations of regressions determine PLS estimations, we did not have to fulfill hard sample distribution assumptions, such as the normality of data (Lohmöller 1989). While all the other constructs were reflectively measured, switching costs was designed as a multidimensional reflective-formative construct (first-order reflective, second-order formative). We therefore applied the repeated indicator approach to estimate the hierarchical latent variable model, and used Mode B measurement for the higher-order repeated indicators. In doing so, we followed Becker et al. (2012), who state that the applied procedure is superior to other approaches when using reflective-formative type models and the number of indicators is equal.

The bootstrapping algorithm was executed to determine the factor loadings and path coefficients, and to assess their significance. In order to ensure the stability of the results, we included 5,000 bootstrap subsamples. In addition, we used the PLS algorithm to examine the measurement and structural model's quality. Finally, blindfolding was used to determine our research model's predictive relevance. We chose the path weighting scheme, which is recommended when the structural model includes reflective-formative hierarchical latent variables, for all the procedures (Becker et al. 2012). We divided the data analysis's results into two analytic steps: First, the measurement model's quality was assessed to ensure its validity and reliability with respect to reflective and formative measures' particular requirements. Second, we examined the research hypotheses and the research model's overall quality. During both steps, we checked for statistical threshold values following Hair et al. (2011).

Measurement Model

We checked the reflective measurement model's quality by assessing its indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. In order to ensure adequate indicator reliability, factor loadings should be higher than 0.70. In a first analysis, item PI_3 did not reach the required threshold value and was therefore rejected. Subsequently, we undertook a new calculation of the model, which showed that all the indicators had significant factor loadings above the required threshold. Moreover, since the composite reliability values of all constructs were higher than 0.70, adequate internal consistency reliability was proven. Table 1 shows all the relevant values, as well as descriptive statistics.

Construct	Item	Standard factor loadings*	Means	Standard deviations	Means (construct)	Standard deviations (construct)	Composite reliability
Dissatisfaction with privacy protection (DP)	DP_1	0.95	5.50	1.39	5.44	1.35	0.96
	DP_2	0.93	5.39	1.43			
	DP_3	0.96	5.43	1.45			

Continuity cost (CC)	CC_1	0.76	4.80	1.70	5.46	1.11	0.81
	CC_2	0.80	5.36	1.48			
	CC_3	0.72	6.22	1.14			
Setup cost (SC)	SC_1	0.88	3.33	1.87	3.12	1.54	0.89
	SC_2	0.86	3.76	2.00			
	SC_3	0.81	2.27	1.53			
Financial cost (FC)	FC_1	0.91	2.15	1.48	2.60	1.65	0.93
	FC_2	0.92	2.45	1.84			
	FC_3	0.87	3.19	2.15			
Peer influence (PI)	PI_1	0.82	2.80	1.46	2.19	0.93	0.74
	PI_2	0.70	1.59	0.90			
Relative privacy protection (RP)	RP_1	0.95	6.09	1.20	6.21	1.05	0.96
	RP_2	0.95	6.25	1.05			
	RP_3	0.95	6.29	1.07			
Switching intention (SI)	SI_1	0.86	2.70	1.69	2.41	1.39	0.92
	SI_2	0.91	2.20	1.47			
	SI_3	0.90	2.33	1.51			
*All indicator loadings were statistically significant at a $p < 0.01 = t > 2.58$ level.							

Table 1. Indicator Reliability and Internal Consistency Reliability

With regard to the convergent validity, the average variance extracted (AVE) of all constructs exceeded the required threshold level of 50% (see Table 2). Furthermore, we assessed the discriminant validity by examining the indicators' cross loadings, as well as the Fornell-Larcker criterion. The indicators' factor loadings were higher than all the cross loadings, indicating adequate discriminant validity. Next, we checked the latent variable correlations against the square root of the specific AVE. Since the AVE's square root values were much larger than the highest latent variable correlation in all the cases (see Table 2), the Fornell-Larcker criterion (Fornell and Larcker 1981) was also fulfilled.

		Latent variable correlations						
	AVE	DP	CC	SC	FC	PI	RP	SI
DP	0.90	0.95						
CC	0.58	-0.18	0.76					
SC	0.73	-0.20	0.28	0.85				
FC	0.81	-0.17	0.10	0.34	0.90			
PI	0.59	0.20	-0.15	0.08	0.10	0.77		
RP	0.90	0.44	0.05	-0.05	-0.04	0.06	0.95	
SI	0.80	0.46	-0.25	-0.28	-0.13	0.24	0.32	0.89
Note: Diagonal elements represent the AVE's square root value for the corresponding construct (denoted in grey).								

Table 2. Convergent Validity and Discriminant Validity

Finally, since switching costs was modeled as a formative second-order construct, we examined the multicollinearity between its three dimensions: continuity cost, setup cost, and financial cost. Following

Diamantopoulos and Siguaw (2006), we found variance inflation factor (VIF) values far below the recommended threshold value of 3.3 (VIF_{CC} = 1.082; VIF_{SC} = 1.215; VIF_{FC} = 1.135), indicating the absence of multicollinearity. To summarize, the measurement model's quality proved to be satisfactory.

Structural Model

We tested our four hypotheses by examining the direct effects of the push, pull, and mooring factors on users' switching intention (see Figure 2). First, dissatisfaction with privacy protection is a strong and significant push factor (β = 0.26, t = 4.01). The greater users' dissatisfaction with WhatsApp's protection of their privacy, the higher their intention to switch from WhatsApp to Threema. Thus, H1 is supported. On the other hand, relative privacy protection is a strong pull factor (β = 0.20, t = 3.62). The more users believe Threema will protect their privacy better than WhatsApp does, the higher their switching intention. Hence, we also found support for H2. However, on examining the mooring factors, the switching costs are a powerful impediment to users' switching intention (β = -0.29, t = 4.42). Users who associate migrating to Threema with high switching costs are less likely to change their messaging application. We therefore found support for H3. Moreover, a closer look at the three dimensions of switching costs revealed that setup cost has the strongest impact (β = 0.64, t = 4.06), followed by continuity cost (β = 0.56, t = 3.37), while financial cost has no significant influence (β = 0.11, t = 0.62). Therefore, the financial cost does not impede switching from WhatsApp to Threema. In contrast to the switching costs, the peer influence to move to Threema is positively related to the switching intention (β = 0.17, t = 2.89), which supports H4. To sum up, we found support for all four hypotheses.

Overall, the push, pull, and mooring factors explain 33% of the variance in users' switching intention. Given that we only focused on the role of privacy as a push and a pull factor, instead of including other dissatisfaction and attraction dimensions (e.g. Xu et al. 2014), this is a satisfactory result. In addition, Stone-Geisser's Q^2 is an indicator of predictive relevance. Following Hair et al. (2011), Q^2 values larger than zero indicate the model's predictive relevance. We conducted the blindfolding procedure to obtain the cross-validated redundancy measures of the endogenous constructs. Since we found $Q^2 > 0$ in respect of all the constructs (Q^2_{SW} = 0.31; Q^2_{SI} = 0.25), our model demonstrates predictive relevance.

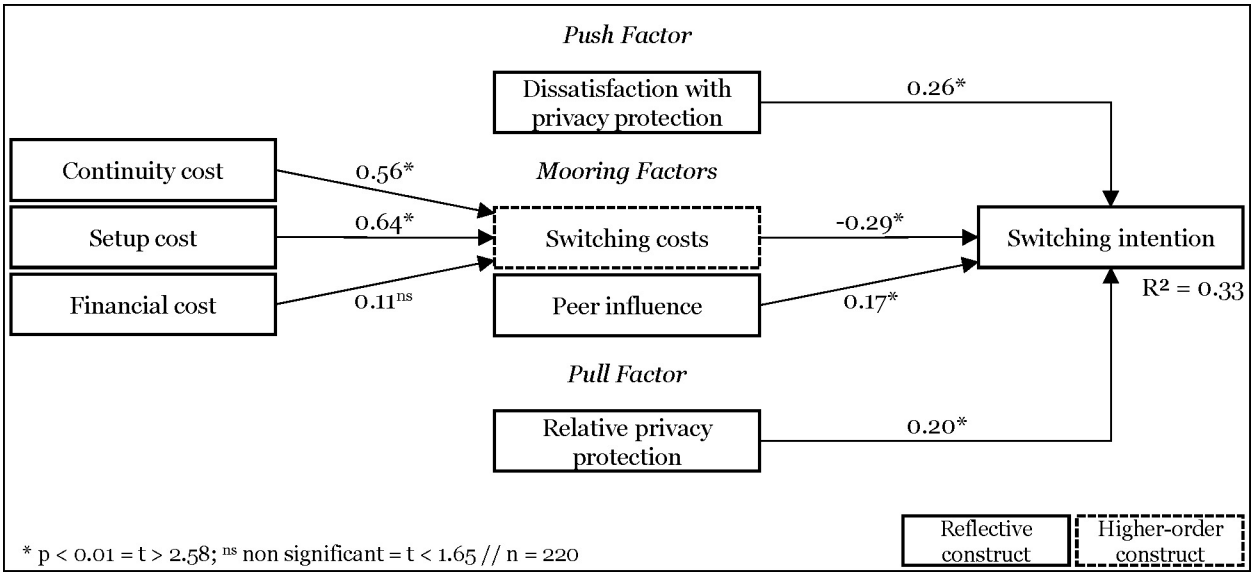

Figure 2. Tested Research Model

Conclusion

This study examined the role that privacy plays in virtual migration by looking at the case of WhatsApp and Threema. In particular, we aimed to answer the question whether WhatsApp users would switch from WhatsApp to Threema for privacy reasons, and what the factors are that would affect their switching

intention. We therefore applied the PPM migration framework and developed an innovative research model. Based on the results of an online survey of 220 smartphone users, our model was proven to have high measurement quality and explanatory power.

Our findings show that privacy protection can be a reason for users to switch their internet service in two respects: on the one hand, their dissatisfaction with privacy protection appears to be a push effect and encourages users to leave WhatsApp. On the other hand, we found that relative privacy protection has a pull effect, attracting WhatsApp users to switch to Threema. However, a comparison of both the push and pull factors shows that dissatisfaction with the privacy protection in WhatsApp has a higher impact on users' switching intention than Threema's relative advantage due to better privacy protection. However, service switching is "moored" by the direct influence of the switching costs and peer influence. Switching costs act as a barrier to service migration. The setup cost and the continuity cost specifically inhibit users from switching from WhatsApp to Threema. However, our results suggest that the financial cost is not a significant obstacle in this context. In contrast, peer influence appears to be a facilitator that promotes service switching.

In sum, while we found that dissatisfaction with privacy protection, relative privacy protection, and peer influence encourage users to switch from WhatsApp to Threema, the switching costs, which inhibit service migration, showed the strongest impact. Thus, even though WhatsApp users are dissatisfied with the protection of their privacy and/or perceive Threema as the superior messenger due to its better privacy protection, they refuse to abandon WhatsApp if high switching costs lock them in. Since the financial cost is not a significant obstacle, our results suggest that users are willing to pay a low monetary fee for improved privacy protection, while psychological and emotional sacrifices discourage them.

Moreover, our findings have implications for providers of internet-based services. Since dissatisfaction with privacy protection pushes users away, commercializing their personal data and offering insufficient privacy protection might be a risk for established providers. At the same time, due to more privacy-friendly services' attraction, opportunities might emerge for new providers that emphasize privacy protection. However, owing to the strong mooring effect of switching costs, new providers should keep the setup cost and the continuity cost as small as possible, for instance, by allowing users to easily transfer their contents and individual settings from their current to an alternative service, by ensuring that the two services' features and usability are similar, and by simplifying inviting friends to use the alternative service.

Regarding the shown push and pull effects, users' perceptions of their current service and the alternative's attractiveness are crucial for their switching intention. However, given that many users are unaware of the privacy deficiencies in WhatsApp and not familiar with Threema's better privacy protection, our study also has limitations. By providing the participants with a comparison of the two services at the beginning of the survey, we examined switching intention under a condition of full information rather than most users' actual information level. Taking this into account, as well as switching costs' strong inhibiting effect, it is quite understandable that most WhatsApp users have not yet switched to Threema. Moreover, the data analysis was based on a student sample, and the survey was conducted in Germany, where the issue of privacy protection and data security in terms of messaging applications has been the subject of public debate in the recent past. Taking this into account, our results may not be representative of all users in all countries. Finally, our findings are limited to the case of WhatsApp and Threema. Further research on different types of internet services (e.g. cloud storage services) is therefore necessary to confirm our results' generalizability.

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Appendix: Measuring Instrument

Construct	Item		Source
Dissatisfaction with privacy protection (DP)	DP_1	How do you feel about privacy protection when using WhatsApp?	Adapted from Xu et al. (2014)
	DP_2	To what extent are you dissatisfied with the protection of your privacy in WhatsApp?	
	DP_3	How do you feel about the protection of your privacy when using WhatsApp?	
Continuity cost (CC)	CC_1	It takes too much time and effort to notify my contacts about my move to Threema.	Adapted from Xu et al. (2014)
	CC_2	It is difficult to build a new network of contacts in Threema.	
	CC_3	It is easier for me to continue using WhatsApp.	
Setup cost (SC)	SC_1	It would bother me to set up and adjust Threema in the beginning.	Adapted from Xu et al. (2014)
	SC_2	Signing up for Threema is annoying.	
	SC_3	Downloading and installing the Threema application takes up too much effort.	
Financial cost (FC)	FC_1	Switching to Threema would involve high financial costs.	Adapted from Burnham et al. (2003)
	FC_2	I am likely to end up with a bad deal financially if I switch to Threema.	
	FC_3	For me, it is annoying that switching to Threema involves financial costs.	
Peer influence (PI)	PI_1	Many of my contacts are dissatisfied with WhatsApp.	Adapted from Xu et al. (2014)
	PI_2	Many of my contacts use Threema.	
	PI_3	Many of my contacts recommended Threema to me.*	
Relative privacy protection (RP)	RP_1	Using Threema will help me protect my privacy better than WhatsApp.	Adapted from Bhattacherjee and Park (2014)
	RP_2	Using Threema will improve the protection of my privacy compared to WhatsApp.	
	RP_3	Using Threema will enhance the protection of my privacy compared to WhatsApp.	
Switching intention (SI)	SI_1	I plan to use both WhatsApp and Threema in future.	Adapted from Xu et al. (2014)
	SI_2	I intend to use Threema rather than WhatsApp in future.	
	SI_3	The likelihood of me switching to Threema is high.	
*Deleted from construct due to low factor loadings.			