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Development of hierarchical structure and analytical model of key factors for mobile app stickiness

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ABSTRACT

Mobile apps (applications) provide services such as information dissemination, knowledge promotion, social media integration, and online shopping, all of which are platforms that enable the strengthening of communication and foster interaction between firms and consumers. The related pieces of literature on the continuous use of mobile apps have noted that apps must have convenience, unique value, social value, incentives, entertainment, and other such qualities to attract continuous usage by customers. As such, stickiness has become the key factor in the business success of apps. For businesses managing mobile apps, the topics of how to design content for mobile device users, how to measure media value and returns, and how to capture the attention of users and make them willing to spend more time using the application are all worthy of exploration. This study proposes the analytical model for mobile app stickiness to measure the significance of various influencing factors of the hierarchical structure and to measure the performance of mobile apps. The study explored key factors that affected user stickiness while examining usage statistics to develop management strategies geared toward mobile app stickiness to improve customer/user loyalty. The proposed model can function as a tool for app planners in measuring user stickiness and app performance while serving as reference for future studies into app stickiness and real-life applications. It can also clarify the influence of key factors influencing app stickiness, which can help app planners develop appropriate strategies and function as a reference point for future improvement and optimization strategies.

Introduction

Riding on the new trend of mobile network technology, enterprises are constructing new communication platforms using mobile devices. Mobile apps (Applications) can provide services such as information transfer, smart push, community integration, and online shopping to meet consumers' needs and strengthen the communication and interactive platform between the enterprise and consumers so as to increase consumer stickiness. The rapid growth of mobile technologies has caused proliferation of various types of apps. Acoording to Dogtiev (2018), mobile apps download reached 197 billion worldwide in 2017 versus 149 billion in 2016 and the total app downloads number will jump to a stunning 352 billion by 2021. Based on eMarketer's (2015) reports, 51.8% of travelers who booked trips via digital channels used mobile devices and 0.75 billion airline boarding passes were delivered via a mobile phone, and it will increase to 1.5 billion passes by 2019. Lipsman (2014) pointed out mobile apps account for more than 50% of time spent on digital media, which means apps have deeply penetrated into the daily lives of smartphone users. In addition, "2016 Taiwan Mobile App Consumer Survey" conducted by the Market Intelligence & Consulting Institute (MIC), there were 13.3 million smart mobile device users in Taiwan; as many as 9.15 million frequently used apps; and there were on average 16 apps (not developed by the users themselves) downloaded per device. Furthermore, according to the "2016 Survey of Mobile Device and App Use Behaviors of Consumers in Taiwan" conducted by the Institute for Information Industry, approximately 68% of the population used smartphones, as many as 85% of the smartphone users had to bring their phones with them when leaving home, and Taiwanese "dependency" on smartphones ranked first in the Asia Pacific region. Given users' heavy reliance on smartphones, how to increase user stickiness through mobile apps becomes critical for enterprises. However, there have been fewer scholars who conducted empirical studies and analysis on mobile app stickiness. Nevertheless, we believe that there is a myriad of factors that influence mobile app user

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stickiness and it would be worthwhile to present the results of this study for mobile app developers and managers. Driven by the mobile trend, enterprises are constructing new communication platforms using mobile devices—apps that can provide services such as information transfer, smart push, community integration, and online shopping—to meet consumers' needs and strengthen the communication and interactive platform between the enterprise and consumers so as to enhance the connections between enterprises and their customers.

As revealed by the literature related to the continued use of apps in recent years (Nikou & Mezei, 2013Ryu, Kim, & Kim, 2014), apps need to present features such as ease of use, unique value, social value, incentive, and entertainment value in order to attract customers' continued use. Hence, stickiness has become the key success factor for an app, and a very worthy topic for mobile app vendors to ponder in terms of how to tailor the content design to mobile device users as well as assess the media value and benefits in order to attract users' attention. The objective is to ensuer users' willingness to spend more time on the app and use it repeatedly. Even though many enterprises started developing mobile apps to generate more marketing opportunities, it remains a major challenge for app developers and managers how to attract users' attention and drive continued use. It is also a challenge concerning how to incentivize users to spend more time on mobile apps in order to maintain positive relationships with customers by tailoring the content design to mobile device users and assessing the media benefits. As found in a review of literature published in recent years on mobile app continuance behaviors and loyalty, Gensler, Völckner, Thompkins, and Wiertz (2013) reported that apps need features such as ease of use, unique value, social value, incentives, and entertainment value in order to attract customers and drive their continued use. On the other hand, Ryu et al. (2014) believe that app planners need to sustain interactions with users over a long period of time in order for users to be willing to spend a certain amount of time and revisit the app for a certain number of times during a particular period of time. Additionally, Furner, Racherla, and Babb (2015) examined the influential factors for mobile app stickiness and mobile interactivity, while Hsiao, Chang, and Tang (2016) explored the factors that influence the mobile app loyalty. Hence, we believe that there are myriad factors that influence mobile app stickiness and these factors are worthy considerations by mobile app developers and managers.

Herrera-Viedma et al. (2004) proposed the consistent fuzzy preference relation method to resolve the consistency issues posed by the pairwise comparisons and the analytical complexities. Normally, other analytical methods require $n \times (n-1) \times 0.5$ pairwise comparisons, but the method proposed by Herrera-Viedma et al. (2004)only requires $n-1$ pairwise comparisons (n denotes the number of elements in the analysis). Furthermore, once the pairwise comparisons are conducted, there is no need to apply a round of consistency tests by using the consistency index. As a result, consistent fuzzy preference relation method not only reduces the number of comparisons required and improves evaluation consistency but also increases analysis efficiency since the menial adjustment step is not required after the analysis. Wang and Chen (2008) incorporated the concept of fuzzy linguistic variables into the consistent fuzzy preference relations method and the proposed fuzzy linguistic preference relations (FLPR) method. This approach can be used to interpret the linguistic fuzziness expressed by decision-makers when conducting preference relations evaluations. As a result, it adds greater applicability and value to multiple-criteria decision analytical methods. Although fuzzy LinPreRa is a relatively new approach, it possesses the characteristics and advantages of both the consistent fuzzy preference relations approach and fuzzy linguistic variables.

This study focused a chain retailer which were store staffs and app users. The fuzzy linguistic preference relations method was used to propose the "analytical model for mobile app stickiness" to measure the significance of various influencing factors of the hierarchical structure and to measure the performance of mobile apps. The results explored key factors that affected user stickiness while at the same time inspected usage statistics to develop management strategies geared toward mobile app stickiness to improve user loyalty.

Theoretical/conceptual framework

Mobile app

Mobile apps are application programs that are downloadable free of charge and marked by the name and logo of a company to facilitate the brand recognition (Bellman, Potter, Treleaven-Hassard, Robinson, & Varan, 2011). They are an extension of the company's existing services, featuring diverse and innovative content. Enterprises even utilize mobile device functions to create lasting benefits for consumers in order to increase the value of mobile marketing for the company and establish a new communication platform between the company and its customers. In the past, consumers could only receive advertisements or information about the company products and related activities shown in newspapers and magazines, but could not interact with the company and its brands in real time. Now, consumers can voluntarily download mobile apps and receive real-time promotional information, search for information, and shop. Previously, the enterprise needed to labor over the hunt for suitable advertisers and purchase of advertisement space in newspapers and magazines, and incurred a large amount of marketing expense. Through mobile apps, consumers could receive real-time information and a shopping platform enabled by mobile devices could also be established so consumers could purchase the products right away while benefiting from the promotional discounts (Ryu et al., 2014).

Current mobile apps are developed based on four key functional principles: "smart push", "local information", "community integration", and "convenient business model". Wu (2015) explored the factors that influence consumers' intention to continually use branded apps and found out central role of app engagement could be positively influenced by effort expectancy, social influence and brand identification. The service content provided by mobile apps can be grouped into three categories based on their attributes: first, information type is to provide information about promotional activities to consumers through mobile apps and organize related information and send it to consumers, as well as utilize location-based services to push promotional information to app users; second, entertainment type is to push entertaining games to app users while exposing users to the organization's brands; third, function type is to incorporate the functions of mobile devices so as to further differentiate the information available through the mobile app, and further the official website can find the closest shop through the app and obtain information about the store activities.

Mobile app stickiness and interactivity

To mobile app planners, their operating goals are no more than attracting users and encouraging them to spend time on and revisit the app in order to increase the income generated through the website or social network. Wu (2015) pointed out consumers' perceived interactivity positively influences effort expectancy which affects performance expectancy, and performance expectancy is a direct factor of continuance use intention for app. Stickiness refers to the application of the concepts of loyalty or continuance behavior to

websites or virtual communities. In other words, with stickiness, a website can continuously attract users to revisit—which is indicative of an individual's attachment to the website, as well as lengthen the time spent by users on the website (Chen, Chien, Wu, & Tsai, 2010; Lu & Lee, 2010). As network users in the modern times are drawn by novelty and change, network community operators need to have in-depth insights into users' needs and create new topics or operating models in order to increase users' continuance intention and existing users' stickiness to the website. The stickiness toward a website—that is, the duration of time spent by users on the site—can be an indicator of users' attitude toward or level of dependency on the products or services (portrayed on the website), and is one of the very success factors for e-commerce. Hence, app planners need an even better design for the website in order to retain users' continuance intention (Wu, Chen, & Chung, 2010). The network industry uses stickiness to measure the use and performance of a platform, provides value through the website, and in turn attracts users to spend time on and revisit the site frequently (Dubelaar, Leong, & Alpert, 2003).

In the past, scholars such as Allison, Bagozzi, and Warshaw (1999) proposed concrete measures to assess the users of social networking sites and believe that stickiness can be measured by the duration, frequency, and depth of the visit. Therefore, stickiness is viewed as a critical success factor for the operation of communities, an indicator for the quality (positive or negative) and overall intensity of the relationships between the enterprise and users, as well as the measurement of one of the enterprise's capabilities in attracting customers to revisit (Elliot, Li, & Choi, 2013). Shina, Jungb, and Changc (2012) showed that consumers' experience of interactivity has a significant moderating effect on the relationships between perceived usefulness, perceived ease of use, and use attitude. Using mobile devices to send interactive messages can stimulate consumers' interest and desire as well as create stronger purchase intentions. Besides, it has become a basic requirement for the enterprise brand to utilize social media to interact with consumers. Consumers' willingness to provide information, brand loyalty, and purchase intention all tend to increase when consumers experience such interactions with the social media (Labrecque, 2014). Kim, Wang, and Malthouse (2015) suggested that sticky apps that attract continuous use can be a persuasive marketing tool because they provide portable, convenient, and interactive engagement opportunities, and also allowing customers to interact with the brand on a habitual basis.

With the fast development of digital marketing, interactivity has gradually become an important concept. Once a consumer connects and starts interacting with other consumers, this consumer will likely become a regular member of a particular community (Wu et al., 2010). During these interactions—that is, a many-to-many type of communication using Internet—a brand new media environment is created which enables information exchange between the website and its users, featuring attributes such as responsiveness, personalization, mutual benefits, connectivity, and synchronicity (Huang, 2003). Hence, mobile app operators need to value more the interactivity between the platform and consumers and provide sound user experience. In the research fields of mobile commerce and mobile advertising, many scholars have developed research hypotheses from the perspective of interactivity theory, as well as measured the effectiveness of vendors' websites or advertisements by using consumers' attitudes when interacting with vendors' sites (perceived interactivity) and interactive behaviors. For example, Kim, Spielmann, and McMillan (2012) examined the relationships between interactivity and consumer experiential value. Based on the definitions of interactivity by previous scholars, they proposed indicators to measure interactivity including two-way communication, synchronicity, user control, customization/personalization, sociability, and displayZhou & Lu (2011) found the ease in connecting to the website and the content offered to be the two factors that would influence interactivity. Both factors are influenced the flow experience (perceived enjoyment, perceived control, focus) significantly.

The dimensions of mobile app stickiness

According to the mobile app stickiness conceptual model proposed by Furner et al. (2015), stickiness is the result of the interactions between the five influential factors of control, communication, responsiveness, context, and mobile self-efficacy. The level of stickiness also varies with an individual's perceived interactivity. Moreover, according to mobile commerce scholars such as Lingling, Kerem, and Xuesong (2015) and Chang (2015), the level of stickiness also varies with the effectiveness of app service providers. Hence, research on factors influencing stickiness has focused on such dimensions as control, responsiveness, and push advertising/promotion. In the research field of mobile advertising, Coursaris and Sung (2012) have examined the interactivity between app service providers and app users from the perspective of advertising and marketing. They found that enhancing interactivity strategies can lead to the most consumption and customer stickiness. Hence, the research on influential factors of stickiness has focused on examining such dimensions as content, communication, responsiveness, and push advertising/promotion of enterprises' websites. In the research field of website design, Lee (2005) examined the content design of websites from the interactivity perspective and pointed out that control, context, and communication are key factors that can influence stickiness. After collating the foregoing related literature, we found that most research on the influential factors of stickiness considered the following six dimensions including control, communication, responsiveness, context, mobile self-efficacy, and push advertising/promotion. Therefore, this study drew from the related literature and focused on examining the aforementioned six dimensions.

Control

Based on the concept of control proposed by Furner et al. (2015), how app features affect perceived interactivity will influence the mobile app stickiness. Enhancing the dexterity, user experience, and user experience consistency (including users' emotional response, perception, preference, behavior, enjoyment, and so on after users' interactions with the system or services) can heighten users' perceived interactivity more as well as increase the time spend on and return visits to the app. Accrding to the definition of control (users' ability to control the display and content of information), we believe that this study should involve three influential factors for the dimension of control including dexterity, user experience, and user experience consistency.

Communication

According to the perspective of interactivity theory, the communication between websites and users based on communicative media or messages features user control, two-way communication, synchronicity, connectivity, and personalization/customization (Cyr, Head, & Ivanov, 2009; Gao, Rau, & Salvendy, 2009). When a user connects on line with other users and starts interacting with them, this user will likely become a regular member of a particular community (Wu et al., 2010). Therefore, service providers need to value the factors that could influence the communication between the platform and users in order to provider sound user experience. According to the concept of communication proposed by Furner et al. (2015), the influence of communication on perceived interactivity characterizes users' degree of focus and online commentaries. Communications based on the online community often require a

large amount of focus and some app content which presents hedonic and utilitarian values (games, rankings, forums, online customer services, and so forth) to attract other users to consult with key reviews in the community (through written messages or chats) before using the app. It will promote interactions and increase user's perceived interactivity in a mobile environment, as well as lengthen the time that users spend on the app and boost return visits. In addition, Xu, Liao, and Li (2008) revealed that the success factor for mobile commerce communication hinges mainly on whether the app's customized and personalized services are properly utilized so personalized and customized information can be transmitted. Customized communications are more likely to reach potential consumers and strengthen the relationships with users (Cheng, Blankson, Wang, & Chen, 2009). Thus, based on foregoing elucidations of communication, we believe that this study should involve three influential factors for the dimension of communication including forum, customized information, and user focus.

Context

According to the concept of context proposed by Furner et al. (2015), context represents a relevant piece of information about the people, event, time, location, object, and so on which exist in the user's environment.Champiri et al. (2015)defined the factor of context as an existing object, including environment, location, state of being (motivation, activity), and the ability to extend. For example, mobile apps can be used to search and look up information, transmit entertainment (online gaming), and shop, regardless of the context. The mobile app technology has matured and is able to provide many interfaces for interactive communication, such as information exchange, real-time interactivity, and multimedia display. Hence, the research on interactivity has mostly focused on features of the medium and the ability to create interactive content or information. Researchers also believe that the more interactive the apps, the more they can attract visitors' continued use (Kim et al., 2012; Teo, Oh, Liu, & Wei, 2003). Thus, based on foregoing elucidations of context by scholars, we believe that this study should involve three influential factors for the dimension of context including online gaming, online shopping, and multimedia display.

Responsiveness

The researches conducted by Jeoungkun, Soongeun, Jinyoung, and Heeseok (2011) and Lingling et al. (2015) revealed that users' continuance intention will be affected by app service providers' effectiveness in meeting the assessment criteria of satisfaction and trust. In other words, the combined effects of factors such as system quality, information quality, and service quality will influence app users' continuance intention. According to the concept of responsiveness proposed by Furner et al. (2015), users' perception, behaviors toward, and emotional response to the system or functions during their operation of the app will influence users' stickiness. Therefore, based on scholars' elucidations of responsiveness, we believe that this study should involve three influential factors for the dimension of responsiveness including system stability, system response time, and function response speed.

Mobile self-efficacy

Based on the concept of mobile self-efficacy proposed by Furner et al. (2015), users' perceived efficacy and behaviors toward the app will influence the app stickiness. Hsiao et al. (2016) conducted research on influential factors for continued app use and proposed factors from the customer value perspective which could influence customers' satisfaction and habits. In other words, the combined effects of factors such as perceived ease of use, perceived usefulness, and perceived enjoyment will influence users' continuance intention of app. Chenyan, Daniel, and Victor (2015) used the research model of customer value, satisfaction, and loyalty to examine the influential factors for users' app continuance intention and users' intention to recommend the app. They proposed factors that address both the utilitarian and hedonic values, including usefulness, quality, esthetics, and perceived enjoyment. Chang (2015) examined the influential factors for loyalty and proposed factors that would influence the perceived value, such as emotional value, social value, convenience, and perceived ease of use. These factors will significantly influence the app loyalty. Based on scholars' elucidations of self-efficacy, we believe that this study should involve three influential factors for the dimension of mobile self-efficacy including perceived ease of use, perceived usefulness, and perceived enjoyment.

Push advertising/promotion

Based on the concept of push advertising/promotion proposed by Coursaris and Sung (2012), Chenyan et al. (2015), and Hsiao et al. (2016), the push service of mobile apps can be used to transmit to users advertisements such as company activities, promotional discounts, and new product launch. If used properly, the mobile app platform can have a significant influence on how often users open the app. The researches conducted by Banerjee and Yancey (2010) demonstrated that mobile coupons such as prizes/sweepstakes, electronic coupons, and gift exchange are important factors for push advertising/promotion. Lin (2013) studied 101 company websites from the perspective of interactivity theory, and classified website interactivity into 23 functions including the website's interactive advertising/promotion functions such as electronic coupon, online ordering, prize/sweepstake, gift exchange certificate, multimedia display, and push media. These functions correlated positively with the attractiveness and customers' assessment of a website. In particular, customer's evaluation of a website would be influenceed by the quality of the electronic coupon, prize/sweepstake, and gift exchange certificate offered by the site, because of the strong demand for these functions (Coursaris & Sung, 2012). Based on scholars' elucidations of push advertising/promotion, we believe that this study should involve three influential factors for the dimension of push advertising/promotion including prizes/sweepstakes, gift exchange certificates, and electronic coupons.

Fuzzy linguistic preference relation (FLPR)

The fuzzy linguistic preference relation is the method used to create a consistent fuzzy linguistic preference relation matrix based on the consistent fuzzy preference relation. It was proposed by Wang and Chen (2008) with the aim to resolve the inconsistency in the decision-making process which has been associated with the fuzzy analytic hierarchy process (AHP) (Wang & Chang, 2007). According to the research conducted by Wang and Chen (2010), at the conceptual level, the fuzzy linguistic preference relation incorporates the concept of fuzzy linguistic variable and simplifies the complex process associated with the fuzzy analytic hierarchy process. At the practical level, the fuzzy linguistic preference relation can effectively rectify the inconsistency in the evaluation outcome as resulted from increasing the number of constructs examined. The fuzzy linguistic preference relation reflects the results of stepwise fuzzy AHP and, thus, still inherits the research steps from the fuzzy AHP. Utilizing the consistent fuzzy preference relations and fuzzy linguistic variables, the fuzzy linguistic preference relation reduces the number of questionnaire items to be designed (i.e., the number of levels of comparison among constructs). Hence, the fuzzy linguistic preference relation reduces the number of pairwise comparisons and effectively resolves the inconsistency among experts' opinions (Chen, Wang, & Wu, 2011). Therefore, the steps in the fuzzy linguistic preference relation are much simpler than those in the fuzzy AHP.

The fuzzy linguistic preference relation has been applied to academic research. For example, in the research field of e-commerce,Chen (2009)applied the fuzzy linguistic preference relation to rank the key influential factors for the operation of web blogs, and found that the most important factors for web blogs included content value. These three factors could be used as a reference by blog operators in the future. For the research of supply chain management, Wang and Chen (2011) have applied the fuzzy linguistic preference relation to rank the four partnering suppliers of the case company in order to provide the company with the basis for formulating management strategies, by using such criteria as transportation cost, defect rate, delay rate, supply flexibility, and administrative capability. In the field of human resources management,Kamis et al. (2012) applied the fuzzy linguistic relation to solve a multifaceted decision-making problem. They investigated the three teaching models proposed by the case school, based on such criteria as the learning model, proportion of time spent on research, teaching method, and credit fee. They presented the model deemed as the best learning method by the majority of the students to the case school as a reference in the school's selection of teaching programs. Moreover, the fuzzy linguistic preference relation also has been applied to decision studies such as group decision making (Huchang, Zeshui, & Meimei, 2014), key supplier relationship evaluation (Tang & Hsu, 2015), and RFID technology selection (Wan, Wan, & Dong, 2016).

Development steps of analytical model for mobile app stickiness

The current study based the construction of preliminary mobile app stickiness hierarchical structure on the mobile app stickiness conceptual model proposed by Furner et al. (2015) and the perspective of interactivity. This study confirmed through expert interviews that the mobile app stickiness hierarchical structure constructed met the needs of empirical assessment. This study also applied the fuzzy linguistic preference relation to derive the weighted value of each construct and influential factor as well as their influence on the open/removal of the app in order to assess the level of each factor on the opening and removing of the app by users. Afterwards, this study analyzed the current performance of the mobile app, and presented optimal strategies to enhance the management of customer stickiness based on the evaluation results. The current study developed three broad parts and seven steps to analyze the mobile app stickiness, as shown in Table 1.

Step 1: To develop preliminary mobile app stickiness constructs from the perspective of interactivity

Although scholars have examined influential factors for mobile app stickiness, Furner et al. (2015) proposed the concept of influential factors for mobile app stickiness, believing that mobile app features would influence the factor of users' perceived interactivity. Therefore, this study anchored its basic model on the concept of mobile app stickiness formulated and proposed as key constructs of the mobile app hierarchical structure control, communication, responsiveness, context, mobile self-efficacy, and push advertising/promotion, by also taking into consideration the related literature on influential factors for mobile app stickiness, loyalty, continuance intention, and interactivity.

Step 2: To develop evaluation factors for mobile app stickiness

As described in Step 1, this study based its construction of the mobile app stickiness hierarchical structure on the mobile app stickiness conceptual model. The study also collated the related literature on mobile app stickiness, loyalty, continuance intention, and interactivity theory to develop factors at a more granular level, i.e., the evaluation factors for mobile app stickiness examined in this study.

Based on definitions of "control", "communication", "responsiveness", "context", "mobile self-efficacy", and "push advertising/promotion", the following evaluation factors were derived: dexterity, user experience, and user experience consistency for the construct of "control"; forum, customized information and user focus for the construct of "communication"; system stability, system response time, and function response speed for the construct of "responsiveness"; online gaming, online shopping, and multimedia display for the construct of "context"; perceived ease of use, perceived usefulness, and perceived enjoyment for the construct of "mobile self-efficacy"; prize/sweepstake, gift exchange certificate, and electronic coupon for the construct of "push advertising/promotion". Based on the indicators for measuring stickiness proposed by Elliot et al. (2013), these influential factors could effect two possible outcomes: opening, or removal of the app. In other words, these factors could influence the outcome of either users opening the app to browse or removing the app from the mobile device, as shown in Fig. 1.

Step 3: To determine the preliminary hierarchical structure of mobile app stickiness

Using the preliminary hierarchical structure of mobile app stickiness developed in Step 1 (Fig. 1), this study interviewed experts and sought their assistance in examining empirically each construct and factor in the hierarchical structure of mobile app stickiness and assessing. The goal was to ensure that the influential factors for mobile app stickiness derived in the study reflected the actual app operations and that the factors were useful for the development of expert-based pairwise comparisons.

Table 1
Development steps of analytical model for mobile app stickiness.

Step	Description
Part I: To develop the hierarchical structure of mobile app stickiness, based on a literature review	
1	To develop preliminary mobile app stickiness constructs from the perspective of interactivity theory
2	To develop evaluation factors for mobile app stickiness
Part II: To confirm the hierarchical structure of mobile app stickiness	
3	To determine the preliminary hierarchical structure of mobile app stickiness
4	To confirm the hierarchical structure of mobile app stickiness
Part III: To collect questionnaires for analysis using the fuzzy linguistic preference relation	
5	To assess the weighted value of each construct and factor using the fuzzy linguistic preference relation
6	To assess the mobile app performance
7	Assessment results of user stickiness

Step 4: To confirm the hierarchical structure of mobile app stickiness

Adopting the method of expert interview, we discussed with mobile app planners to make necessary revisions (of constructs) and examine any cognitive differences related to the influential factors for stickiness. this study also drew from experts' opinions to adjust, revise, remove, or merge the 18 factors and then classified, labeled and defined them based on their attributes. They would be removed if our assessment showed that particular constructs or factors were not existent in the industry. Contrariwise, they would be added if any constructs or factors existed in the industry but were left out from the study. The hierarchical structure of mobile app stickiness could be established and used to develop the questionnaire survey by also incorporating the results of expert interviews. Therefore, the questionnaire survey could be used to sassess the constructs and factors for mobile app stickiness.

Step 5: To assess the weighted value of each construct and factor using the fuzzy linguistic preference relation

Given insufficient knowledge and a large amount of fuzzy information, a correct decision may not be reached by one individual alone or on the basis of one indicator because decision-makers will find it quite difficult to arrive at the correct decision with only limited attention and less information (Hsu and Lin, 2006) The research conducted by Wang and Chen (2008) showed that the fuzzy linguistic preference relation was developed by incorporating the concepts of fuzzy linguistic variable and fuzzy analytic hierarchy process in order to effectively simplify the complex computation process and rectify the inconsistency problem. This method can effectively solve the inconsistency problem which may occur when experts interviewed fill out the questionnaire, and in turn increase the overall effectiveness and accuracy. Once the hierarchical structure of mobile app stickiness was confirmed, the questionnaires collected were analyzed using the fuzzy linguistic preference relation to calculate the importance weights. This study adopted the triangular fuzzy number proposed by Büyüközkan (2009) and combined it with the fuzzy linguistic variable to calculate the weighted value of each construct and factor as well as assess how each construct and factor would influence the opening and removal of the app. This approach would help mobile app operators formulate suitable strategies to improve and optimize the app.

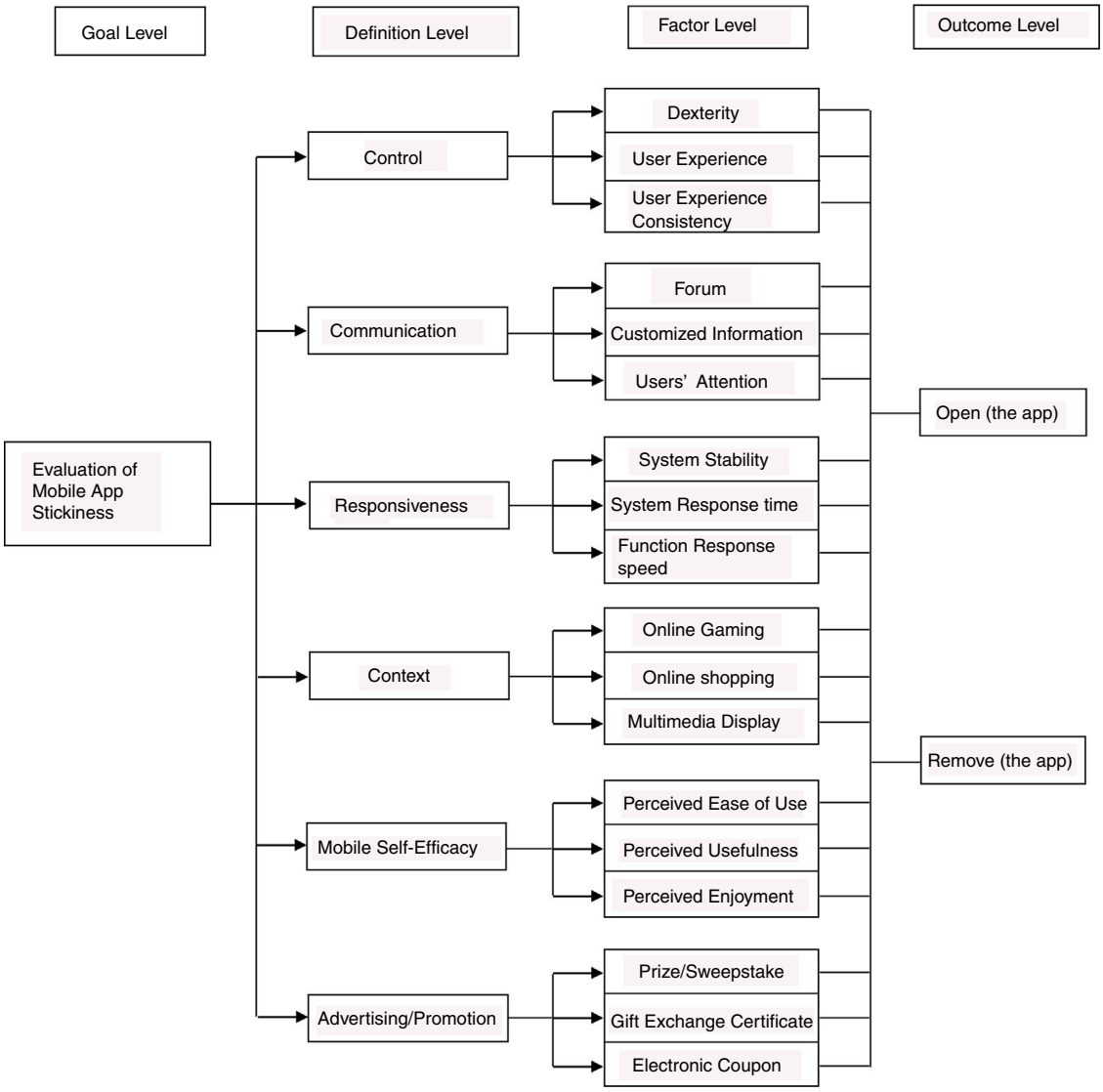

Fig. 1. The evaluation of hierarchical structure for mobile app stickiness.

Step 6: To assess the mobile app performance

This study applied the fuzzy linguistic variable instead of the positive/negative variable in the analytic hierarchy process could increase the accuracy in assessing the degree in which each factor influenceed the opening and removal of apps by users based on the computational concept proposed by Wang and Lin (2009).

Step 7: Assessment results of the user stickiness

Factors were ranked based on their respective weighted values as computed in Step 6 to show the state of mobile app user stickiness. This systematic and analytical model could provide mobile app operators with a basis for reference when planning and optimizing strategies.

Empirical research

This case company was established in 1995 with the full financial backing of a large, well-known distributor in Taiwan. It has fully implemented the policies of centralized distribution and membership to increase the rate of merchandize turnover and the quality of retail store management. It also offers loyalty discounts and rewards programs. Adhering to the operating philosophy of "integrity, care, and teamwork", the company pursues sustainable operation and growth and has successfully connected 100 of its retain stores via a network. The company has grown rapidly, established more than 360 retail stores to serve the local populations in Taiwan, Penghu and Kinmen, and launched mobile apps in 2014. The first phase focuses on such services as electronic membership card, online DM (direct mail), online shopping, and (information) push. In terms of operation management, the case cosmeceutical chain store sells directly and provides quality products, complete services, sound organizational personnel training, and quality staff. It also fully engages in corporate social responsibilities, responds to the global trend of pursuit of happiness, and uses technology to support innovations in its sales intelligence system, supply chain management system, complete and effective logics setup and system. In order to understand the organizational structure of the case cosmeceutical chain store, this study resorted to expert interviews to learn about the related internal organizational structure of the company and the responsibilities of each department. Based on the expert interviews conducted, the app planners were tasked with five main responsibilities, which include:

- Input scheduled content: To support scheduled promotional content and DM visuals as well as ensure the simultaneous availability of content on the digital media;
- Plan marketing activities: To plan app-related activities, such as coupons, games, or Internet activities;
- Input merchandize coupons: To request coupons from the merchandize department and plan scheduled issuance of coupons;
- Remove system bugs: To assist users in resolving problems encountered when operating different devices and the systems;
- Plan new functions: To enhance user interface/user experience and plan new functions and layouts.

The hierarchical structure of mobile app stickiness and influential factors for stickiness

This study conducted in-depth interviews with three app planners at the case cosmeceutical chain (including the deputy general manager of the operations department as well as the manager and specialist of the marketing planning team). The experts interviewed were all mobile app operations planners with professional experience and knowledge. The experts interviewed were invited to share their practical views on the hierarchical structure of mobile app stickiness and to examine whether or not the hierarchical structure of mobile app stickiness constructed in the study was sound. Based on the results of interviews, the experts recommended the following for the preliminary hierarchical structure of mobile app stickiness:

- The six constructs and 18 evaluation factors generally matched the practice in the industry and hence no constructs or factors needed to be added or removed.
- The definitions of the constructs and factors for measuring stickiness sounded more academic and could easily cause misunderstanding on the part of interviewees. Hence, recommendations were made to craft a set of definitions that were easier to understand in order to increase interviewees' grasp of how to answer the questions and the rate at which they could answer the questions.
- During the research, the questionnaires were circulated to two types of targets: (1) expert users (store managers/deputy store managers) and (2) regular users. At the time of the research, the retail stores of the case cosmeceutical chain—as many as 237 stores—were located mostly in the northern region. Thus, recommendations were made to interview mostly people in this region in order to raise the sample representation.
- Most interviewees would form a cognitive understanding of how to answer the questions about influential factors and outcomes related to stickiness based on the definitions of constructs and factors. However, interviewees might not be able to as quickly grasp the concepts of factors such as "context" and "self-efficacy". Thus, during the design of the questionnaire, adding some examples when drafting the instructions could help interviewees to establish a cognitive understanding of how to answer the questions.

This study defined (Tables 2 and 3) the dimensions and factors for measuring the mobile app stickiness based on the previous literature collated, industry data, and interview results of experts, and used these constructs and factors for questionnaire survey.

Table 2
Definitions of the dimensions for mobile app stickiness.

Dimension	Definition
Control	The user's instinctual recognition of the functions of the app system interface and how to operate and control.
Communication	The app operator engaging in two-way communication with users by transmitting information related to activities, products, promotional discounts, and so forth.
Responsiveness	The user's perception of, behaviors toward, and emotional response to the system or functions during his/her operation of the app.
Context	The state in which the user is operating the app, such as looking up information or engaging in mobile gaming and online shopping.
Mobile self-efficacy	The user's perceived efficacy and behaviors—for example, the user will continue using the app if he/she deems the process of downloading coupons to be easy.
Advertising/promotion	The app transmitting to users such advertisements as promotional discounts and latest activities through push media.

Table 3
Definitions of the factors for mobile app stickiness.

Dimension	Factor	Definition
Control	Dexterity	Clicking the app and sliding the content interface, the user can quickly and smoothly browse the entire screen.
	User experience	The user's perceived responsiveness and feedback after coming in contact with the products, system, and services, such as users' emotional response, preference, perception, and behaviors.
	User experience consistency	The website/app design, content, design concept, and functions need to be consistent. In addition, the model needs to be simplified and behaviors optimized so users can quickly figure out how to operate the site/app.
Communication	Forum	Areas where users can communicate with one another and exchange opinions.
	Customized information	To provide information that is interesting and relevant to users based on their preference and needs, such as location-based recommendations.
	User focus	The community feedback consulted by other users before using (the app), such as rankings, forums, and reviews.
Responsiveness	System stability	The system remains stable without jittering or collapsing during users' operation of the app.
	System response time	The amount of time that the system takes to retrieve the app when users click the app.
	Function response speed	How fast app functions start when users click them.
Context	Online gaming	The user can play interactive games via the app.
	Online shopping	The user can order products directly on line.
	Multimedia display	The multimedia display where rich and detailed descriptions, images, and audiovisual products/content or service information are shown.
Mobile self-efficacy	Perceived ease of use	The user's perceived level of ease when operating the app, for example, whether or not the app is easy to operate and does not require strenuous efforts.
	Perceived usefulness	The user's perceived level of usefulness of the app, for example, the app allows the user to obtain useful information or feel the convenience.
	Perceived enjoyment	The user's perception of the app content, for example, the user enjoys, has fun with, and feels entertained by certain activities in the app.
Advertising/promotion	Prize/sweepstake	Interactive gaming that provides many types of product as prizes or sweepstakes.
	Gift exchange certificate	A gift exchange certificate that can be redeemed at the store for many types of product, such as sunscreen trial packs.
	Electronic coupon	An electronic coupon that can be redeemed at the store for many types of product.

Analytical results of expert users for the mobile app stickiness

During the phase when expert user questionnaires were collected, responders needed to be very familiar with the connections between the mobile app and customers and able to assess the app's current and expected performances. Hence, the questionnaires were distributed to the store staff on-site—the store manager and deputy store manager—at the training center of the case cosmeceutical chain. There were altogether 50 questionnaires distributed and, with the exclusion of three incomplete questionnaires, 47 valid questionnaires were collected.

The weighted value of fuzzy linguistic preference relation for each factor was calculated based on the assessment and preference of each expert user. The calculation formula used was the same as that for the weighted analysis of constructs. Also, the weighted values calculated for both the dimensions and factors were combined and summarized in a table to facilitate subsequent analysis of the research results. In addition, the final stickiness weighted value for each factor was calculated following the foregoing steps. The final weighted values were also ranked as shown in Table 4.

This study multiplied the weighted value for construct and that for each factor to derive the total weighted value, which also shows a clear view of how each factor ranks. Table 4 shows that the top-ranked factors are dexterity, user focus, and perceived ease of use, and the lowest-ranked factors are forum, online shopping, and multimedia display.

Expert users' assessment of mobile app performance

This study used the fuzzy linguistic measure and triangular fuzzy number to score the 47 valid questionnaires collected. The corresponding weighted linguistic variables for the 18 influential factors were converted to triangular fuzzy numbers using the fuzzy linguistic calculation formula. The weighted values for each factor and its weighted values for the two possible outcomes were combined using the fuzzy linguistic calculation formula to derive the app stickiness, that is, the values for opening and removing the app as shown in Table 5.

The expert users focused on the factor level by assessing the mobile app performance for each factor. The ranking of outcome influence (opening and removing) of the 18 factors in Table 5 shows the following. The factors of function response speed, perceived usefulness, dexterity, electronic coupon, system stability and gift exchange certificate were associated with a higher rate of opening (strong performance). On the contrary, the factors of forum, user focus, multimedia display, online gaming, and customized information were associated with a higher rate of removing (suboptimal performance).

In the study, the values of the two outcomes (opening and removing) were subtracted from each other and analyzed from the perspective of the Two Factory Theory proposed by Herzberg (1968). The analysis showed that expert users viewed factors of "dexterity", "function response speed", "perceived usefulness", and "electronic coupon" as motivation factors and, if any value added of the mobile app could satisfy users, they would then continue

Table 4
Expert users' weighted values for dimensions and factors of mobile app stickiness .

Dimension weighted value (A)		Factor weighted value (B)		Total weighted value (A*B)	Ranking
Control	0.173	Dexterity	0.347	0.060	1
		User experience	0.328	0.057	4
		User experience consistency	0.325	0.056	7
Communication	0.167	Forum	0.315	0.053	17
		Customized information	0.330	0.055	10
		User focus	0.355	0.059	2
Responsiveness	0.169	System stability	0.335	0.056	5
		System response time	0.334	0.056	6
		Function response speed	0.331	0.056	9
Context	0.159	Online gaming	0.337	0.054	12
		Online shopping	0.331	>0.053	16
		Multimedia display	0.332	0.053	15
Mobile self-efficacy	0.171	Perceived ease of use	0.342	0.058	3
		Perceived usefulness	0.328	0.056	8
		Perceived enjoyment	0.330	0.056	6
Advertising/promotion	0.161	Prize/sweepstake	0.337	0.054	11
		Gift exchange certificate	0.329	0.053	14
		Electronic coupon	0.333	0.054	13

Table 5
Expert users' assessment of outcome influence of mobile app performance.

Factors	Total weighted value	Open (the app)	Remove (the app)
Dexterity	0.060	0.564	0.436
User experience	0.057	0.548	0.452
User experience consistency	0.056	0.542	0.458
Forum	0.053	0.506	0.494
Customized information	0.055	0.540	0.460
User focus	0.059	0.526	0.474
System stability	0.056	0.562	0.438
System response time	0.056	0.560	0.440
Function response speed	0.056	0.566	0.434
Online gaming	0.054	0.530	0.470
Online shopping	0.053	0.550	0.450
Multimedia display	0.053	0.528	0.472
Perceived ease of use	0.058	0.550	0.450
Perceived usefulness	0.056	0.564	0.436
Perceived enjoyment	0.056	0.544	0.456
Prize/sweepstake	0.054	0.558	0.442
Gift exchange certificate	0.053	0.562	0.438
Electronic coupon	0.054	0.564	0.436
Value for outcome influence		0.548	0.452

opening and using the app. Overall, the expert users felt that the app did not perform well for the influential factors of "communication" and "context" with an opening rate of 0.548 (approximately 54.8%) which is higher than the removing rate of 0.452 (approximately 45.2%), or 1.2 times higher.

Analytical results of regular users for the mobile app stickiness

This study then distributed questionnaires to regular users of the case cosmeceutical chain store's mobile app. There were altogether 50 questionnaires distributed and 50 valid questionnaires were collected. Similarly, we used the fuzzy linguistic measure and triangular fuzzy number proposed by Büyüközkan (2009) to score the 50 valid questionnaires. The calculation of weighted values of fuzzy linguistic preference relation for various factors was performed based on the regular users' preference assessment. The final weighted values of mobile app stickiness for each factor was calculated in Table 6. According to Table 6, the top ranked three weighted factors are perceived usefulness, electronic coupon, and perceived ease of use, and the lowest ranked three weighted factors are forum, multimedia display, and online gaming.

Regular users' assessment of mobile app performance

Similarly, we used the fuzzy linguistic measure and triangular fuzzy number to score the 50 valid questionnaires collected. The weighted values for 18 influential factors and their weighted values for the two possible outcomes were combined using the fuzzy linguistic calculation formula to derive the mobile app stickiness, and the values for opening and removing the app, which is shown in Table 7.

The regular users focused on the factor level by assessing the mobile app performance for each factor. The ranking of outcome influence (opening and removing) of the 18 factors in Table 7 shows the following. The factors of online gaming, perceived usefulness, prize/sweepstake, electronic coupon, and perceived ease of use were associated with a higher rate of opening (strong performance). On the contrary, the factors of user experience consistency, multimedia display, user experience, gift exchange certificate, and perceived enjoyment were associated with a higher rate of removing (suboptimal performance). Therefore, the analysis showed that the regular users viewed factors of "perceived usefulness", "prize/sweepstake", "online gaming", and "electronic coupon" as motivation factors and, if any value added of the mobile app could satisfy users, they would then continue opening and using the app. Overall, the regular users felt that the app did not perform well

Table 6
Regular users' weighted values for dimensions and factors of mobile app stickiness.

Dimension weighted value (A)		Factor weighted value (B)		Total weighted value (A*B)	Ranking
Control	0.165	Dexterity	0.342	0.056	7
		User experience	0.327	0.054	15
		User experience consistency	0.331	0.054	11
Communication	0.162	Forum	0.321	0.051	18
		Customized information	0.342	0.055	9
		User focus	0.337	0.054	12
Responsiveness	0.164	System stability	0.337	0.055	8
		System response time	0.329	0.054	13
		Function response speed	0.334	0.055	10
Context	0.161	Online gaming	0.332	0.053	16
		Online shopping	0.337	0.054	14
		Multimedia display	0.331	0.053	17
Mobile self-efficacy	0.176	Perceived ease of use	0.329	0.058	3
		Perceived usefulness	0.343	0.060	1
		Perceived enjoyment	0.328	0.057	4
Advertising/promotion	0.173	Prize/sweepstake	0.330	0.056	5
		Gift exchange certificate	0.329	0.056	6
		Electronic coupon	0.341	0.059	2

for the influential factor of "communication" with an opening rate of 0.540 (approximately 54.0%) which is higher than the removing rate of 0.460 (approximately 46.0%).

Differences of evaluation for the mobile app stickiness between expert and regular users

The top ranked stickiness factors valued by the expert users (the store staff) were "dexterity", "user focus", and "perceived ease of use", whereas the top ranked stickiness factors valued by the regular users (regular consumers) were "perceived usefulness", "electronic coupon", and "perceived ease of use". This result shows that there was some overlap between the expert and regular users in their perceptions of the mobile app: (1) A comparison of the "constructs" valued by both the store staff and regular users revealed that both valued highly the "mobile self-efficacy" and "control" constructs, which suggests that, for both the store staff and regular consumers, the top criterion for their continuance intention was optimized perceived self-efficacy of and operational experience with the app; (2) The store staff valued more the "user focus" than the "electronic coupon" which was valued more by the regular users. Hence, a recommendation could be made for the store staff to become more educated about the benefits and setup of the "electronic coupon" so as to bridge the perceived stickiness gap between the store staff and regular consumers.

Research conclusions

This study used fuzzy linguistic preference relation to calculate the influential factors for mobile app stickiness and establish a analytical model for mobile app stickiness. The study findings showed that this model could be used as a tool to measure user stickiness periodically. When app planners formulate strategies to optimize the platform, they can create a well-thought-out plan and various stickiness management mechanisms based on users' prioritization of stickiness influential factors, outcomes, and the performance value as well as the rate for improvement of the mobile app. Therefore, we arrived at the following conclusions related to the mobile app stickiness management:

Maintain the strong performance for certain stickiness factors

1. The top ranked five factors associated with the highest rates of opening the case company's app were "online gaming", "perceived usefulness", "electronic coupon", "prize/sweepstake", and "perceived ease of use". Hence, seizing on the strong performance for these five factors, this study recommends: (A) to continue incentivizing and interacting with customers by utilizing favorable offerings such as online gaming, prizes/sweepstakes, gift exchange certificates, and electronic coupons to strengthen the "context" and "push advertising/promotion" in order to attract mobile app users to open the app and browse; (B) periodically, the app's user interface and user experience need to be optimized, the user touch control simplified, and new functions and layout planned, by using perceived ease of use, perceived usefulness, and perceived enjoyment to strengthen the "mobile self-efficacy" and offer users simpler and more convenient mobile apps.
2. Improve the suboptimal performance for other stickiness factors

The top ranked five factors for which urgent improvement in performance is needed are "customized information", "forum", "user focus", "perceived enjoyment", and "online shopping". Hence, this study recommends the following targeting these five areas: (1) resources are limited and thus could be diverted toward functions that need improvement, as the forum and user focus do not influence the user stickiness as much; (2) providing too much marketing information could create information overload for users. Hence, providing useful and customized information based on users' preference and needs can help users simplify their consumption decision-making and raise their purchasing power; (3) using online gaming and task wall to strengthen perceived enjoyment and increase users' odds of winning prizes in order to enhance interactivity; (4) the app planners should fully utilize the context to understand users' critical needs when it comes to online shopping and simplify the operating process and shopping decision-making.

According to the mobile app stickiness analytical model and the total weighted value for each influential factor, this study found out users value put more attention on factors such as "perceived usefulness", "electronic coupon", "dexterity", and perceived enjoyment". Hence, we recommend that mobile apps facilitate such user perceptions as ease of use, no need for strenuous efforts, convenience, usefulness, and fun. The apps could also push information to users by starting with content that is interesting to them such as goodies, promotional discounts, and store activities, which will more likely attract users to click and open the app, foster a

Table 7
Regular users' assessment of outcome influence of mobile app performance.

Factors	Total weighted value	Open (the app)	Remove (the app)
Dexterity	0.056	0.562	0.438
User experience	0.054	0.530	0.470
User experience consistency	0.054	0.518	0.482
Forum	0.051	0.468	0.532
Customized information	0.055	0.468	0.532
User focus	0.054	0.480	0.520
System stability	0.055	0.558	0.442
System response time	0.054	0.558	0.442
Function response speed	0.055	0.565	0.435
Online gaming	0.053	0.573	0.427
Online shopping	0.054	0.551	0.449
Multimedia display	0.053	0.526	0.474
Perceived ease of use	0.058	0.567	0.433
Perceived usefulness	0.060	0.573	0.427
Perceived enjoyment	0.057	0.536	0.464
Prize/sweepstake	0.056	0.573	0.427
Gift exchange certificate	0.056	0.530	0.470
Electronic coupon	0.059	0.570	0.430
Value for outcome influence		0.540	0.460

certain level of dependency on the app, and in turn influence users' perceptions of the enterprise's brands.

Management implications

This study point out that mobile app planners did not share common understandings of the mobile app with the store staff. Their different roles and responsibilities led to their different orientations, which is indicative of a relatively weak relationship. Therefore, the planners should take into consideration the opinions of the frontline staff at the store in order to create service content with high customer value and increase the mobile app stickiness. We recommend that the enterprise establish a platform for both sides to share information internally and maintain interactions with users through the store staff in order to understand users' mobile app needs and establish common value and common goals.

This study also found that mobile app planners did not share common understandings of the mobile app with the store staff. Their different roles and responsibilities led to their different orientations, which is indicative of a relatively weak relationship. Hence, the planners should take into consideration the opinions of the frontline staff at the store in order to create service content with high customer value and increase the mobile app stickiness. Therefore, the current study recommends that the enterprise establish a platform for both sides to share information internally and maintain interactions with users through the store staff in order to understand users' mobile app needs and establish common value and common goals.

Research limitations

This study focused on the retail industry. However, due to different corporate cultures and industry types, the perceptions of app planners and users toward app stickiness influential factors may also be different. Considering the data source and the time required, the current study conducted empirical analysis only on the mobile app of one company. The mobile app stickiness influential factors thus derived may not be sufficiently representative. Therefore, subsequent research could be directed at analyzing empirically the mobile apps of multiple retailers or different industries, increase the number of samples, and compare the user stickiness and outcomes.

Conflict of interests

The authors declare that they have no conflict of interest.

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