

Mobile Services Personalization Evaluation Model

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Abstract

The proliferation of personalized mobile services is emphasizing the need to determine the users' perception of how successful personalization is, and how it can be improved and in which facet. For some users, personalization can be useful; others may find it confusing and prefer to turn it off. The motivation of the article is to explore and understand the success criteria of delivering personalized mobile services. The goal of this research work is to develop a theoretical model called Personalization Evaluation Model (PEM) to measure the effectiveness of personalization of mobile services. The main purpose of Personalization Evaluation Model (PEM) is to improve the understanding of the effectiveness of personalization of mobile services by providing new theoretical insights of measuring key variables of personalization. Moreover, PEM should provide the theoretical basis for practical testing of the effectiveness of personalized mobile services. The constructs developed for PEM are primarily adapted from the previous research of personalized mobile services.

Keywords: *Personalization, Mobile services, User satisfaction, Evaluation, User modeling, User acceptance*

1. Introduction and Motivation

Nowadays, mobile information services are delivering more than a user perceives to need. One size fits all approach seems not effective especially for mobile services. Instead, this approach may cause dissatisfaction or can annoy the users. To overcome this challenge, personalization can play a key role to deliver a personalized experience. It is providing a mean of fulfilling users' needs more effectively and efficiently and, thus increasing users' satisfaction. By providing successful personalization, a high level of user satisfaction and a pleasant user experience can be achieved. On the other hand, some features of personalization can cause problems and may outweigh the benefits of personalization. Therefore, there is a need to measure the effectiveness of personalization of mobile services.

It is evident that existing literature has not provided adequate theoretical and empirical evidence to show whether the user likes personalized services [1]. It is also necessary to examine the impact of personalized services on user satisfaction and the factors that affect the satisfaction with these services. Although, the effectiveness of web personalization is evaluated, but there is little attempt to evaluate the effectiveness of personalization of mobile services [2]. According to [3], personalization is iterative processes that can be defined by the three stages understand, deliver and measure cycle. The purposed personalization evaluation model focuses the "measure" phase of the process. Personalization is a multidimensional concept, and measuring such a multidimensional construct is always a challenge [4]. Few of

the studies have investigated whether personalized services can enhance user satisfaction, or why user satisfaction is increased. In order to take full advantage of personalization technology, we need to have a better understanding of how users respond to the service and its theoretical basis [1]. During evaluation of personalized services, the perception of personalization should not be asked directly as *do you like personalization* or *what is your perception about personalization* [5, 6]. It is not easy for a user to perceive personalization as a whole. Instead, it should be posed in terms of variables it is supposed to serve.

The main objective of this work is to explore and identify the success criteria of delivering personalized mobile services. Moreover, the objective is to propose a comprehensive evaluation framework to measure the effectiveness of personalized mobile services. It is hoping that the proposed personalization evaluation model will help to understand and evaluate the user's perception of the quality of personalization.

The measuring constructs used in this work are mainly adapted from previous research on personalization of mobile services. Since the main objective of personalization is to increase the user satisfaction; therefore, the primary construct to measure the personalization is user satisfaction. Varieties of constructs are used in previous research to measure some aspects of personalization. We have proposed PEM to provide a comprehensive approach to evaluate the effectiveness of personalization of mobile services. Section 2 provides a brief literature review and theoretical basis for PEM. The proposed personalization evaluation model is presented in Section 3. It also elaborates the measuring constructs and hypothesis development process. Section 4 concludes the paper and describes further work.

2. Literature Review and Related Work

The purpose of this section is to analyze the existing empirical literature on the evaluation of personalization. The literature reviewed is primarily drawn from the domain of mobile services especially having a focus on personalization. The objective of the analysis is to (1) understand the state of the art of mobile services personalization and research pertaining to the evaluation of personalization; (2) identify existing personalization variables that may lend support to the proposed model, and (3) determine the extent to which the proposed model goes beyond the existing research. The literature review has reflected a broad variety of personalization variables. However, it is observed that similar constructs were given different names in different studies. We have analyzed the conceptual and operational similarity among the constructs and make it possible to adapt the diversity of constructs.

Personalization of mobile services has a primary goal of reducing information load and delivering highly relevant contents to the users. Personalization is considered as a key factor of success of mobile devices and services [7]. For example, in [8] preference based news are delivered to mobile devices and filtered according to the preferences of a user and by tracking the user's behavior. Furthermore, contents can be adapted according to the device profile so that users can easily navigate and browse. According to [9] user satisfaction depends also on the technical quality, usability, and design of the mobile services. The measuring phase of personalization process [3] focused on measuring the impact of personalization by determining how much a user is satisfied with the personalization. Authors also suggested that there is a significant demand to develop appropriate metrics to determine personalization impact. Moreover, it is suggested that measuring the impact of personalization can help to understand the deficiencies of methods of personalized delivery. It can also help to serve as feedback for possible improvements to other components of personalization process. Jameson [10] has discussed predictability, comprehensibility, controllability, unobtrusiveness, privacy user experience, and system competence as usability issues of personalized systems.

A literature review [11] showed that different studies have used 44 different variables related to user-centered evaluation of personalized systems. Though, different names were used by the different authors, but the concept was identical. The key terms used were usability, perceived usefulness, and appropriateness of adaptation (detailed list can be found in [11]). A prototype evaluated in a study [12] used only two metrics to measure the personalization; effective rate as a quantitative metric and overall success factor as a qualitative metric. The effective rate represents the percentage of times the system was successful in providing what the user wanted. The overall success factor denoted the average of “actual success factor” for all provided results. The ratio between overall success factor and desired success factor provides an indication if a personalization system meets the given quality restrictions. However, limited evaluations cannot provide a complete overview of the effectiveness of personalization perceived by users.

Personalization has become an essential feature of variety of mobile services and few studies have measured the effectiveness of personalization. Mobile advertising is a popular research area where personalization is playing a prominent role. General attitude towards mobile advertising was measured by five key attributes [13], personalization, entertainment, informativeness, irritation and credibility. In this study, authors measure attitude of users in general; and made an assumption that perceived personalization of mobile advertisement affects the attitude towards mobile advertising. Again, asking users about personalization as a whole will not give the true evaluation of personalization. The metrics, like accuracy, consumer lifetime value, loyalty value and purchasing experience were suggested [3] to evaluate the effectiveness of personalization in m-commerce. However, much more work is needed to develop more ways to measure personalization impact [3]. In a case study [14], perceived relevancy and expectancy are utilized as evaluation factors to understand the attitude and behavior of users towards personalization. The author found that the relationship from perceived relevance to attitude, intention and actual use was significant. There are four kinds of user motives for using personalized systems under different theoretical perspectives of personalization [4]. These include aesthetic value for architectural personalization, social welfare/psychological well-being for relational personalization, productivity/efficiency for instrumental personalization, and material and psychic wellbeing for commercial personalization. Authors also argued that it is not reasonable to measure everything of personalization using a single yardstick. Other measurement constructs should be developed to suit different contexts of personalization.

A study has investigated the effects of location-based mobile personalization on user’s trust and distrust of mobile services and looked at two aspects: preference personalization and location personalization [15]. Personalization goal is to increase the usefulness and acceptance of information and services [7]. According to [16], personalization is about correct guessing about what the users perceive as added value. Therefore, there is a need to evaluate the personalized offerings in terms of user satisfaction. An empirical study [17], found that perceived enjoyment and perceived ease of use are the most decisive factors in adoption of personalized mobile services.

Personalization can bring user satisfaction, but it can also be irritating for users as well. According to [18], the negative consequences of personalization have rarely been investigated. Therefore, there is a need to evaluate to develop a comprehensive view of the success of personalization. A similar work [1] has evaluated personalized services and measure user satisfaction with four dimensions- information content, personalized service, user interface, and system value.

Supporting Theories

Theory of information load [19] and theory of uses and gratification [20] is briefly described in this section. The information overload theory implies that user satisfaction increases when the recommended content fits user interests. This theory focuses on the principles of least effort and information load. Zipf's principle of least effort [21], states that each individual will adopt a course of action that will require the least average work from the person. The principle of least effort predicts that information seekers will minimize the effort required to obtain information.

An alternative to the least effort theory is information overload, which means users are given more information than they can manage within a given time frame. That is the user would prefer to remove some information in order to reduce the required effort for finding the target. We can say that personalized services can increase user satisfaction by reducing information overload if such services can provide accurate service delivery.

Theory of uses and gratification indicates that motivations for information access affect user satisfaction. According to this theory, users' access information with a specific purpose and play an active role in selecting the source and information they like. User's gratification with a personalized service is vital for effective personalization. Different users may have different goals to personalize a service. It is quite natural that user's satisfaction increases with the achievement of the goal. The following Table 1 gives an overview of research variables and conceptual descriptions derived from the literature studied.

Table 1. The Conceptual Definitions of Research Variables

Research variables	Conceptual descriptions	References
Perceived information load	The degree to which a person believes that the information is filtered and reduced information load	[23, 25-28]
Perceived Relevancy and Accuracy	The degree to which a person believes that received information is according to the user's profile, preferences and context.	[5, 7, 8, 14, 15, 25, 26, 29]
Perceived Effort	The degree to which a user utilizes her/his effort to personalize a service.	[1, 30]
Perceived Trust	The degree to which a user has trust on personalized service.	[15, 18, 31, 38]
Perceived Privacy and Security	The degree to which a user has confidence that his/her personal data is secure.	[18, 27, 39]
Perceived Goal fulfillment	The degree to which a user believes that s/he has achieved the goal.	[4, 17, 32, 33]
Perceived User Control	The degree to which a user feels that s/he has control over her/his personal data.	[23, 30, 34]
Perceived device adaptability	The degree to which a user feels that her/his performance is increased due to device adaptability.	[29, 32, 35]
Perceived Effectiveness	The degree to which a user feels that overall personalization is effective.	[29]

3. Personalization Evaluation Model

Measuring the effectiveness of mobile services personalization is highly important. It is said by [3] that you cannot manage what you cannot measure. Personalization is not a single variable rather it is a combination of several complex variables. It is required to evaluate all personalization related variables to assess the impact of personalized services. Moreover, studying different personalization variables can help to identify which variable requires modification to increase the user's experience. In the literature studied, most of the services or systems have treated personalization as a single variable. For example, a study [22] has treated personalization as composite variable called relationship drivers used to express personalization in terms of time, location and adaptation to user profile. Treating personalization as a composite variable can lead to a variety of challenges to measure it. In a study [15], authors argued that the impact of mobile personalization is still inconclusive. According to [23], there is no science if personalization methods, techniques and algorithms cannot be effectively evaluated. User's evaluation feedback can play a key role in measuring and enhancing personalization. The use of feedback can be used to adjust preferences and can improve the user satisfaction [24]. Based on the theories and partially evaluated variables of personalization in different studies, we have proposed some constructs (see Table 1 and Figure 1) to evaluate different aspects of personalization.

Purposed Research Model and Hypotheses Development

This section describes mobile services personalization evaluation model in brief. The identified constructs are mainly derived from the literature of personalized mobile services.

User satisfaction and improved user experience are the main goals of personalization. Personalized mobile services can improve users' experience by personalizing different aspects of services. Identification of measuring constructs for the evaluation of personalization can be valuable and useful for the community. The personalization metrics can be different in different domains. For example, in personalized search engine, the metrics of success should be measured by means of perceived relevance of search results. However, it is difficult if not impossible to produce a definite set of metrics for successful personalization. In order to evaluate those aspects and measure the overall user satisfaction with personalization, we have proposed the PEM to measure the effectiveness of mobile personalized services.

User Satisfaction: User satisfaction is a common term used to represent overall satisfaction of a user with a service. It is quite natural that if a user is satisfied with a service, s/he will continue to use the service. In a way, we can say that user satisfaction has a strong correlation with use intention. These two constructs are particularly common to assess the success of various services or systems in different domains such as e/m-commerce, e-Government, and e/m-learning [39]. Personalization has the direct impact on user satisfaction, and it is essential to measure this construct to evaluate the effectiveness of personalized mobile services. Users can get frustrated if satisfaction metric is low and people can stop using personalized systems [3]. It is essential to determine the variables which are irrelevant for a personalized service and should be replaced with more relevant metrics.

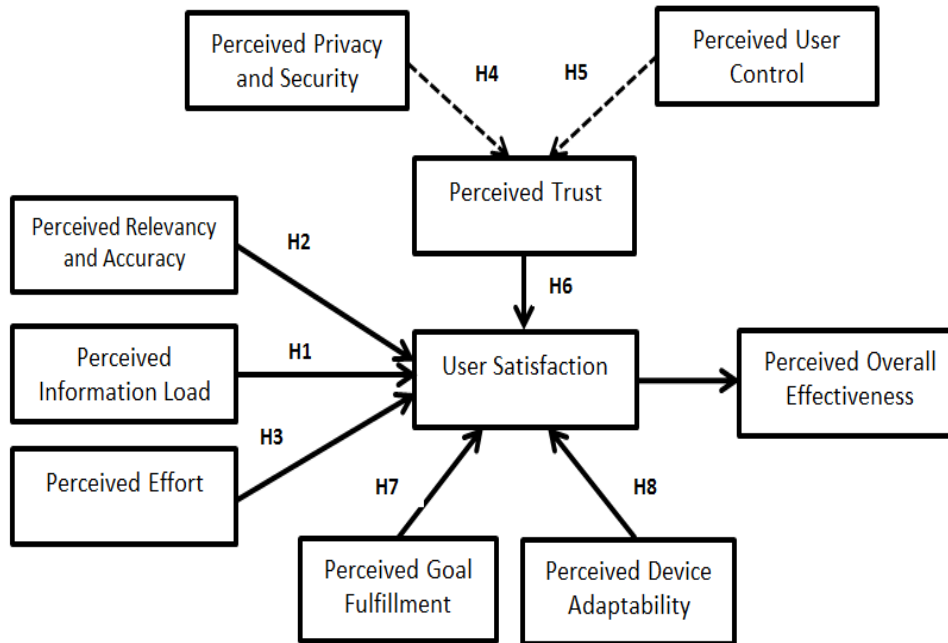


Figure 1. Purposed Research Model (PEM)

Perceived Information load: Information overload is an increasing problem as more and more data is available. Personalization can play a key role in reducing the information load. In case of personalized mobile services, reducing the information overload is a key feature of personalization. It is essential to exploit the knowledge about the situation of the user, the adopted channel and the environment to reduce the information load [25]. According to Herbert A. Simon, “What information consumes is rather obvious: it consumes the attention of its recipients”. Hence a wealth of information creates poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.” An empirical study [27] has investigated the effects of numerous irrelevant messages and found that information load has a direct impact on user’s satisfaction. Depending on the existing studies of personalization, it can be expected that the following relationship can hold.

H1: Perceived reduced information load has a direct positive effect on user’s satisfaction.

Perceived Relevancy and Accuracy: It describes the contents validity whether the received information is according to the user’s profile and context. This construct has significance in personalization and requires careful measurements. Perceived relevance is used to measure the success of personalization as a positive effect [5]. Perceived relevance is a key factor to measure the personalization [5]. However, it should not be the only construct to measure the effectiveness of personalization. User profile and context are playing a key role in personalization of mobile services [7, 25]. Therefore, perceived relevancy construct requires measurement. Users appreciate relevant and accurate information and can satisfy the users [14, 15, 26]. The construct describes how closely the information is related to a user’s interests and needs. We anticipated that the following relation can hold.

H2: Perceived relevancy and accuracy have a direct positive effect on user's satisfaction.

Perceived Effort: One purpose of personalization is to support a user to reduce the effort required to operate a system or a service successfully and effectively. Perceived effort is a fundamental construct to measure how much effort utilized to retrieve personalized contents. In addition, it also describes how much user was convenient to personalize a service. The measurement of this construct is important in the context of mobile services due to the limitations of mobile devices. An effort requires to adapt and utilize the personalization feature has a considerable effect on user satisfaction. It is related to the ease of learning and understanding of personalization feature by a user. In our opinion, the focus of perceived ease of use is different from perceived effort. Perceived ease of use has the expectation of positive intentions, whereas perceived effort has the expectation of adverse intentions. In a study [30], the authors have used a term perceived convenience to describe the same purpose.

Moreover, it is essential to consider how much a user is supported to complete a task without making so many mistakes. Personalization can help in taking over parts of routine tasks that may place heavy demands on a user's time and effort [10]. An adaptive interface is a key feature to support the user in reducing the effort and time to accomplish a task. In case of mobile services, personalized and adaptive interfaces are of high importance. Feedback intrusiveness [3] requires a lot of effort from users and can affect the user satisfaction. Here, the aspect of 'effort' also includes the setup and configuration to make personalization features functional.

H3: Perceived reduced effort has a direct positive effect on user's satisfaction.

Perceived Privacy and Security: This is another key construct to measure for evaluation of personalization. Since users shared their personal and sometimes financial information, security and privacy concerns are natural. Enhanced privacy and security can increase the trust of a user which in turn can raise user satisfaction. Privacy related intrusiveness in personalization is a challenge [3, 27]. For successful personalization, it is desirable to achieve a balance between usefulness of personalization and the extent of privacy a user wants to reveal. Privacy is an integrated part of personalization. Every person may have different priorities for privacy. Users may not want to share much information as they do not have trust or they are inquisitive about their personal information. Some people may want to share more personal information to gain more personalized experience [27]. We hypothesized as follows

H4: Perceived privacy has a positive effect on a user's trust.

Perceived User Control: Personalization is not meant to take control away from a user rather it puts a user more in control while using a service. It is quite natural that if a user feels more in control over her/his data and adaptation process; s/he will trust more and this ultimately will result in user satisfaction. As described by [36], user is responsible for initiation of the adaptation process and should have control over it. The user may be willing to control adaptability, modifiability and re-configurability of personalization process. In a survey [23], authors recommended that to achieve a right balance between privacy and personalization put people in control. Users' trust will rise if services allow control over their information. The tradeoff between benefits and risks of personalization should be explicit depending on the level of user's involvement. In a study [2], authors described that it is a proactive approach to protect the data on user's side which will put the user in more control. Sundar [30] has also advocated that perceived user control can increase the user satisfaction. We have anticipated the following hypothesis.

H5: Perceived user control has direct positive effect on a user's trust.

Perceived Trust: Trust is a fundamental requirement in a personalization process. User satisfaction and trust have a natural relationship. According to [31], trust has a significant impact over personalization. The tradeoff between privacy and personalization is a challenge. In a study [18], the authors suggested that trust can be a mediator between personalization, privacy and adoption intention. In PEM, we proposed that both privacy and user's control over her/his personal data can enhance trust and ultimately can increase the user's satisfaction. Another study [37] described that privacy concerns can lead to lack of user's trust and could result in dissatisfaction. We anticipated that the following relationship holds

H6: Perceived trust has a direct positive effect on user's satisfaction.

Perceived Goal Fulfillment construct describes the realization of a user's goal by personalized service. The main purpose of personalization is to fulfill user's goals and needs. Without the fulfillment of goal, personalization will be of no use. In addition to getting things done, users also have a need to "simply enjoy things" [4]. Further, authors argue that personalization systems may not only fulfill the functional aspects of human needs but also their entertainment aspects. Users are more focused and precise on their goal (finding a specific piece of information) in mobile services [32]. Playfulness or joyfulness can also be a goal to use a personalized service. We can say, perceived goal fulfillment has a direct positive impact on user's satisfaction.

H7: Perceived goal fulfillment has a direct positive effect on user's satisfaction.

Perceived Device adaptability: A variety of devices can be used to access information and services. It is significant that a service can adapt the personal preferences of a user's device. It can play a significant role in personalization and can make it convenient and efficient use of a service. As suggested by [32], the interface, layout and contents can be modified depending on the various conditions; including the user's preferences, the limitations of the device and the environment. Device adaptability can lead to increase the performance which in turn may increase the user satisfaction.

H8: Perceived device adaptability has a direct positive effect on a user's satisfaction.

Perceived Overall Effectiveness: Measuring the overall effectiveness of personalization of a mobile service is a central construct here. This construct describes the effectiveness of user's actions while using a personalized service. One of the main purposes of personalization is to enhance productivity of users. This construct describes to reduce the overall effort and completion of a goal in a short time, or can improve overall efficiency of a user. It reflects the overall usefulness and effectiveness of the personalized service.

Table 2. The operational definitions of research variables

Research Variables	Operational definitions
Perceived Trust	TR1: I feel confident when sharing personal data. TR2: I feel using personalized service is trustworthy.
Perceived Goal Fulfillment	PG1: I achieved my goal using personalized service PG2: Personalized service increase my efficiency
Perceived Effort	PE1: Personalized service reduce my effort PE2: It is easy to use a personalized service PE3: It is easy to become skillful with personalization.
Perceived relevancy and accuracy	PR1: Service is personalized to my context. PR2: Information is relevant to my interests. PR3: Information is accurate according to my profile.
Perceived Information load	PL1: I am receiving necessary information. PL2: I feel obtrusiveness is decreased. PL3: I am not missing crucial information.
Perceived User Control	PC1: I feel in control over my personal data. PC2: I feel in control over my privacy for personalization.
Perceived Privacy and Security	PP1: I feel privacy is correlated with desired personalization level. PP2: I feel personalization is not invading my privacy.
Perceived Device adaptability and performance	PA1: Personalized service is adaptable to my device profile. PA2: I feel device adaptability enhance my performance. PA3: I think device adaptability is efficient enough.
Perceived Overall Effectiveness	PO1: I feel personalization increase my performance PO2: I feel service personalization is useful.

4. Conclusions and Future Work

Personalization is a multidimensional construct. Providing personalized services is highly sensitive to user's context and needs. There is a need to evaluate and optimize personalization. The main objective of this work is to explore and identify the success criteria of personalization of mobile services. In this study, we have proposed an evaluation model to measure the impact of personalization. Different constructs are adapted from partially evaluated personalized systems or services performed by different studies. User satisfaction is utilized as a central construct in the research model due to its high relevance to personalization. Different hypothesis and measuring instrument is proposed to measure the impact of different variables of personalization. The next phase of the research is to evaluate the personalization evaluation model with a variety of personalized mobile services. We are hoping that the evaluation phase will help to improve the research model.

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