Design Aesthetics Leading to M-Loyalty in Mobile Commerce

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Abstract

Researchers have previously examined the Technology Acceptance Model [TAM] in many contexts, including the Internet. More recently TAM has been enhanced to include a hedonic component of enjoyment but the effect has rarely been investigated in a mobile commerce context. In addition, specific antecedents of TAM related to design aesthetics have not been examined within the mobile domain. Our research filled these gaps, and discovered that visual design aesthetics did significantly impact perceived usefulness, ease of use, and enjoyment, all of which ultimately influenced users' loyalty intentions towards a mobile service.

Keywords: visual design, aesthetics, mobile commerce, technology acceptance model, enjoyment, m-loyalty

Section type: Research

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1. Introduction *

Mobile commerce (m-commerce) has the potential of serving customers in wireless environments for both business and pleasure. Technical advances have provided users with powerful and affordable computing and communications devices such as PDAs (Personal Data Assistants) and cellular phones. This 'mobile' Internet is growing at an astonishing rate, and is expected to surpass the desktop-based Internet in a few years [48, 55]. In 2003 the worldwide ring-tone market alone was worth $3.5 billion, up 40% from 2002 and this represents about 10% of the global music market [100]. The mobile terminal will become '*the* access point' for all sorts of 'anytime, anywhere' services [1, 30, 63].

The adoption of m-commerce is dependent on consumer acceptance of new and well-designed technologies [8]. To gain an understanding of the mobile consumer, recent research examined a variety of topics, including value creation through service offerings to the consumer [4], impact of mobile commerce on business operations [51], contexts for mobile use, and extended business applications for mobility [73, 80]. However, only a few studies have examined factors that influence actual adoption of mobile commerce [70, 96] or hedonic components, such as fun or entertainment that induce consumers to use a mobile device. Of particular relevance to this investigation, Bruner and Kumar applied TAM to consumer adoption of handheld Internet devices and found that, as proposed by Davis [24], a user's perceived ease of use (PEOU) is a key determinant of its perceived usefulness (PU), which in turn influences behavioral intention and actual use. However, they inserted an

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additional component of "fun" to their model, and made comparisons between a PC and mobile device related to both ease of use and fun. Results indicated both perceived usefulness and especially fun associated with the device contributed to consumer adoption.

In another vein, user interface design and aesthetics of the website were found to be important for users' acceptance of technology [29, 86]. Tractinsky played a major role in the consideration of aesthetics or beauty of the website interface [53, 88, 89] and found high correlations between perceived aesthetics and perceived ease of use. Schultz [81] found that graphical design elements, including color, photographs, font style and layout, affected the perceived usefulness of a Web page. Finally, van der Heijden [90] linked perceived attractiveness of a website to perceived usefulness, perceived ease of use, and perceived enjoyment, all of which had implications on intended and actual use of the site.

2. Context for Mobility

Relatively little is know about the factors influencing mobile applications and adoption. There are some exceptions. Yang validated TAM in a mobile commerce setting, and explored potential impacts of various individual characteristics (such as age, gender, innovativeness, and past adoption behavior) on perceived usefulness and ease of use. Wu and Wang [94] considered perceived risks, cost, and compatibility within m-commerce and found compatibility to be the most important determinant of intention to use the technology. Pedersen [72] extended TAM with subjective norms and behavioral control into a decomposed theory of planned behavior for early adopters of mobile commerce services. Others investigated mobile adoption for a specific application. For example, Kleijnen et al. [49] examined adoption of mobile gaming, Pagani [71] explored mobile multimedia services (photo messaging, mobile e-mail, video messaging, and postcard messaging), and Luarn and Lin [61] investigated behavioral intention to use mobile banking.

Over time, increased attention focused on how to display information effectively on small screens. Duchnicky and Kolers [28] studied the effects of different screen sizes, including the ability to read on different window heights and line widths. Their study, along with others [26, 74, 83], demonstrated that comprehension rates on a smaller screen were generally as good as those on larger screens. While stationary workstation screens differed by ratios of six to one at most, mobile screens differed by a ratio of 24 to one [79]. Between 1992 and 2002 Nokia phone volume and weight shrunk by a factor of five [58]. At the same time, mobile phone display size increased from two lines displaying eight characters each to a matrix display of 128 by 128 pixels. In 2004, the Nokia 6600 mobile phone had a laptop equivalent display. Methods to convert Web-based graphic file formats into wireless protocols have been developed [43, 75], although effective design applications are far from simple adaptations of large screen technology to its smaller counterpart [7, 41, 44].

Expanded graphical displays have enabled a fuller examination of the aesthetics of a mobile interface. Sarker et al. [78] examined interface characteristics and network capabilities that affect the implementation and acceptance of wireless phones. They found that users were "quite forgiving of physical limitations of the device due to technological constraints, they were bothered by flaws in the interface of the devices". According to Kiljander and Jarnstrom [47] user interface style is a combination of the user interaction conventions, audio-visual-tactile appearance, and user interface hardware.

3. Design Aesthetics and Mobility

Interface design is increasingly important as companies and entertainment websites compete for rapidly increasing customers [91]. The sensory experience of the website can also determine whether a user stays and shops [42, 77]. Visual design refers to the balance, emotional appeal, or aesthetic of a website [34] and it may be expressed through colors,

shapes, font type, music or animation. Some research in this area has shown a relationship between "aesthetic beauty" and e-trust [45].

The original TAM has been widely used to explain technology adoption. Legris et al. [56] provided a comprehensive review of its use. They listed 39 factors affecting system satisfaction, however visual design was not included.

We predicted that usefulness and enjoyment of the device would result in mobile loyalty. Figure 1 shows the model we tested.

[Place Figure 1 about here]

Although not tested using a mobile device, Schultz examined the effect of graphical design elements on perceived usefulness of a library website page. Participants were presented with a simple page layout, and an enhanced version, including an image header, decorative font, colors, and graphical buttons. Results indicated that the enhanced design positively affected users' impression of the site, including perceived usefulness. Zhang and Li [98] found the "perceived affective quality" of a system had a significant positive impact on both perceived usefulness and perceived ease of use. Tractinsky noted: "Based on the design characteristics of interactive systems, users perceive and evaluate various attributes of the system (e.g., ease of use, usefulness), including its aesthetics." Related to this, Kurosu and Kashimua [52] and Tractinsky manipulated the layout of objects on an ATM machine and found this affected customer evaluation of the machine's "beauty" which influenced other system attributes such as ease of use.

In a study that specifically examined user interface design and usability for a wireless device in m-commerce, many principles of interface design were found to be transferable to mobile devices. Issues included content, user interaction with the device, reading text on small screens, rapid serial visual presentation, and browser types but aesthetic elements of the site mentioned (with reference to color and size of tables) were only mentioned in one paragraph. Despite this, the author concluded that "aesthetics, along with

usability, may also be part of designing an overall enjoyable user experience with mobile devices," Likewise, Chan et al. [11] address usability and mobility, but omitted any examination of the aesthetics of design. Instead they were more concerned with differences across mobile device platforms.

Van der Heijden presented a model for the Internet in close alignment with that proposed by us. Using a TAM framework he introduced a new construct of "perceived attractiveness." Drawn from the psychology literature [27], this was defined as "the degree to which a person believes that the website is aesthetically pleasing to the eye." Van der Heijden found empirical support that perceived attractiveness of the website did influence usefulness, enjoyment, and ease of use. Further, perceived ease of use impacted perceived usefulness and perceived enjoyment. Three items captured users' impressions of website attractiveness and referred specifically to overall site attractiveness, and of the site layout or colors.

In our investigation we drew on research on visual aesthetics in a variety of situations, and applied this work in the specific context of a mobile device. We expected that perceived visual aesthetics of the mobile interface would impact user perceptions of usefulness and ease of use of the device. Therefore the following hypotheses were tested:

H1*:* Design aesthetics of a mobile site will positively influence perceived usefulness.

H2: Design aesthetics of a mobile site will positively influence perceived ease of use.

4. Augmented TAM

Recently, TAM was applied in a consumer context with the addition of a "hedonic" factor that relates to user pleasure when using it [14, 23]. In work involving the Internet this hedonic component has been described as "fun", "playfulness" [17, 67, 93] or "enjoyment".

Online retail shopping has been suggested to have both utilitarian and hedonic dimensions and that vendors can create aesthetically rich shopping environments that consumers enjoy.

Moon and Kim conducted an experiment on the Internet and suggest there is a positive relationship between PEOU and perceived playfulness, and between perceived playfulness and attitude or intention toward use of the World Wide Web. They say: "when individuals are in the playfulness state, they will find the interaction intrinsically interesting: they are involved in the activity for pleasure and enjoyment rather than for extrinsic rewards". However, it should be pointed out that they had no specific and defining antecedent variable to enjoyment. Childers et al. examined characteristics of the interactive shopping environment, such as navigation and convenience, that were expected to result in an enjoyable shopping experience as well as perceived usefulness and ease of use. These relationships were supported but aesthetics of the website were not considered.

Various antecedents of playfulness have been identified, including website characteristics. Seven such characteristics were: content, speed, ease of use; experimentation; variety; navigation; feedback; focused attention; and control. All characteristics were found to influence perceptions regarding playfulness of the site.

Zhu et al. [99] included antecedent variables of trust and enjoyment along with perceived ease of use and perceived usefulness as precursors to intention to use a mobile device in their untested conceptual model.

Finally, an investigation by Bruner and Kumar served as an important catalyst to our study. In their work, they tested different perceptions for fun by users on a desktop PC, a wireless phone simulation, and a PDA. Results demonstrated that the desktop and PDA were equally easy to use, but the PDA was perceived as more fun. Contrary to expectations, the wireless phone simulation was perceived as less fun than the desktop. Strong effects were found for ease of use related to both usefulness and fun of the device, however specific characteristics of the device responsible for influencing EOU and fun were not articulated. "

In our investigation, we used a real mobile phone to examine specific elements of visual aesthetics as antecedents to perceived usefulness, perceived ease of use, and perceived enjoyment. This resulted in further hypotheses:

H3*:* Design aesthetics of a mobile site will positively influence perceived enjoyment.

H4*:* Perceived ease of use of a mobile site will positively influence perceived usefulness.

H5: Perceived ease of use of a mobile site will positively influence perceived enjoyment.

5. M-loyalty

While early electronic commerce research indicated that website design elements could influence online satisfaction and sales [60], most research ignored the importance of website design factors and how they can influence customer satisfaction and the likelihood that customers will revisit a website resulting in customer loyalty [66]. Online loyalty or e-loyalty has been defined as a consumer's intention to buy from a website or to visit it again [21, 31, 97]. Studies on the Internet suggest that if users are satisfied with the design of a website, they are more likely to exhibit e-loyal behavior [5, 25]. Website content can have an influential effect on contributing to repeat site visits [54].

Gommans et al. [38] discussed an untested conceptual framework for e-loyalty in which five elements were suggested as contributing to online consumer intentions to revisit the website or purchase again from an online vendor. One element proposed was website design, including ease of navigation, personalized features, designing for targeted customers segments, language options, and effective search functions. Yoon tested a model in which website properties and navigation functionality were expected to result in website trust and website satisfaction. The properties included width of product selections, accuracy of online

information and firm's reputation, while navigation functionality involved overall operational efficiency, usefulness of help functions, and speed of online navigation. Yoon further suggested that trust results from confidence in the website and the buyer-seller exchange, while satisfaction relates to factors that induced users to return to the site. Website trust was found to be significantly related to properties of the website, while satisfaction was significantly related to navigation functionality, and both trust and satisfaction positively influenced e-loyalty.

In alignment with the definition of loyalty for an Internet site, mobile loyalty, or m-loyalty also depends on user willingness to revisit a site [10, 57]. Lin and Wang examined the determinants of customer loyalty in mobile contexts and found m-loyalty to be influenced by perceived value, habit, trust, and satisfaction. Chae et al. found that information quality was a key element of the mobile Internet and that it enhanced customer loyalty for mobile services.

Bruner and Kumar found that user attitudes significantly influenced their intention to use a device or service. In a mobile context perceived usefulness, perceived playfulness, and perceived ease of use correlated positively with user intentions, although they did not specifically measure loyalty. Similarly, Lee et al. observed that perceived usefulness and ease of use explained a significant percentage of the variation in attitude toward using the mobile Internet, which in turn influenced actual usage.

These findings suggested the final two hypotheses:

H6: Perceived usefulness of a mobile device will positively influence m-loyalty.

H7: Perceived enjoyment of a mobile device will positively influence m-loyalty.

No direct path between design aesthetics and loyalty was considered in our model. Flavián et al. have recently suggested that usability elements do not follow a direct path to consumer loyalty, but are mediated through other constructs that are antecedents to loyalty.

6. Research Methodology

6.1. Participants

Data collection took place in a large Canadian city in Western Canada. Participants were solicited through a poster placed in a variety of public spaces and university bulletin boards. To participate, individuals were required to have used a cell phone for at least one year. Sixty participants who were either Chinese or Canadian in origin (30 in each category) were selected. We originally expected differences between the two groups due to culture, age, and gender, but t-tests for between group differences were not significant, so the groups were combined to test our model. Demographics of the sample are given in Table 1.

[Place Table 1 about here]

6.2. Experimental Site and Device

Given our emphasis on aesthetics, an attractive site was required for our research, with no interference from a slow or faulty connection. Most WAP sites in North America and Europe are primarily text-based, however the Lonely Planet (www.lonelyplanet.com also accessible from a mobile phone [wap.lonelyplanet.com]) offered visual treatment. Therefore the City Guide version of this site was chosen for the experiment. A typical WAP site has a black and white pure text format, but our study featured a colored background and text cells, as well as photographs, maps and icons. Screenshots of all pages are shown in Appendix A. A Nokia 6600 Internet enabled cell phone was used before it had been released to the Canadian market. This phone seemed very suitable as a basis for the investigation as it has one of the largest screens on the market and a superior color display (65,536 TFT) capable of laptop quality images. A joystick also permitted easy navigation.

To prevent problems with downloading and browsing delays, website pages were downloaded and saved on the cell phone. Based on feedback obtained from our pilot focus group (of 6), participants were not aware of this and perceived the connection to be "real."

6.3. Experimental Tasks

A pilot study was used to pre-test potential tasks and check the experimental protocol, which included survey items and interview questions. Participants were initially asked to perform three information retrieval tasks: finding movie listings at a local theatre, choosing a restaurant in a different city, and booking a hotel in a different city. The restaurant task was found to be most suitable; it was preferred by the pilot subjects and afforded excellent visual design opportunities. For this task, photos of the interior of the restaurant and the map showing its location were included.

For the full study, each participant performed the experiment under the supervision of an investigator. The session began with a brief introduction and completion of the background data sheet, followed by familiarization with the Nokia 6600 device, including a written summary of key functions (shown in Appendix B). Once it was determined that participants were comfortable with the device they were read the following:

> *"Imagine that you have just arrived in San Francisco to meet up with an old friend. Your friend has suggested that you select a restaurant on your cell phone, and call her back with the address. Use the bookmarked CityGuide site to accomplish this task. Spend as much time as you need browsing through the featured listings for San Francisco. There is no need to actually write down any information or make any calls. Just let me know what your selection is when you're finished."*

The device was then handed to the participant with the browser opened at the introductory page of the site. The site listing featured four restaurants, and most participants took between five to fifteen minutes to complete the task. He or she was then asked to complete a survey, followed by open-ended interview questions; these were tape-recorded. The interview questions were intended to solicit additional information about the participant's experience with the experimental task and interface; they probed how

participants liked the site, what they would change, and whether or not they found the device useful. Finally, participants were debriefed and received a $20 honorarium.

6.4. Content and Construct Validity

Content validity considers how representative and comprehensive the items are in providing the results. Validity is assessed by examining the process by which the construct items were generated [84]. Constructs should draw representative questions (items) from a universal pool [20, 46]. In our research, survey items were adapted from previously validated work on design aesthetics [22], PEOU [50], PU [62], Perceived Enjoyment [9], and Loyalty . All items were constructed as agree-disagree statements on a seven-point Likert scale. The complete survey is given in Appendix C.

Construct validity assesses the extent to which a construct measures the variable of interest. Results of the varimax rotation on the 19 survey items is given in Table 2. All loadings are greater than 0.5, as recommended by Hair et al. [39] (convergent validity). There are no high cross-loadings of items in one construct with items in other constructs (discriminant validity). To further verify discriminant validity, Fornell and Larcker [33] suggested that correlations between items in any two constructs should be lower than the square root of the average variance shared within a construct. As shown in Table 3, this criterion is met.

Internal consistency (construct reliability) of the five factors was examined using Chronbach's α-value. As shown, α-values ranged from 0.83 (for m-loyalty) to 0.94 (for enjoyment), which is well past the threshold recommended by Rivard and Huff [76] and Nunnally [69]. Therefore, our instrument encompassed satisfactory content, convergent validity, and discriminant validity.

[Place Table 2 about here]

[Place Table 3 about here]

7. Results

A structural equation modeling (SEM) approach was used, as it possesses many advantages over traditional methods. For example, it can simultaneously test the structural and measurement model, does not involve assumptions of homogeneity in variances and covariance of the dependent variables across groups, and allows for more complete modeling of theoretical relations [37].

Path analyses were performed to test the hypotheses using the variance-based Partial Least Square (PLS) method as used in recent IS studies [2, 36, 95, 68]. PLS was chosen over co-variance based methods, as it has fewer demands on residual distributions and sample size [13]. Additionally, it is appropriate for testing theories in early stages of development [32], as it supports both exploratory and confirmatory research.

With regards to sample size, Chin and Gefen et al. recommend that the minimum sample size for a PLS analysis should be the larger of (a) ten times the number of items for the most complex construct; or (b) ten times the largest number of independent variables impacting a dependent variable. The proposed model had five items in its most complex construct (enjoyment), and at most two independent variables impacting a dependent variable. Therefore, our sample size of sixty exceeded the recommended threshold of fifty.

Figure 2 shows the results of the analysis. PLS does not generate overall goodness-of-fit indices. Therefore, model validity was primarily assessed by examining the structural paths and R^2 values [18]. As recommended by Chin, bootstrapping (with 500 sub-samples) was performed to test the statistical significance of each path coefficient using t-tests. All path coefficients were significant. The findings supported all hypotheses at a minimum $p<0.05$ level, as summarized in Table 4.

[Place Figure 2 about here]

Approximately 46% of the variance for m-loyalty towards mobile services is accounted for by the variables in the model ($R^2=0.46$). Note that the R^2 value of PEOU is

relatively small (0.053). This, however, does not represent a threat to the model's validity. In general, low R^2 values are common in behavioral science research (for example, see [12]). In addition, PEOU is influenced by a single construct in our model (design aesthetics). As such, it would possess a low R^2 value when compared to multi-relationship models.

[Place Table 4 about here]

8. Discussion and Interpretation

Emerging research has begun to explore adoption issues for mobile services however this work is still preliminary. In particular, there is a lack of understanding of how design elements can influence the experience of the mobile user, and ultimately his or her loyalty towards using the service.

Our study sought to investigate gaps in the literature, and to apply established TAM constructs of perceived ease of use and perceived usefulness to the mobile services domain. Our findings supported previous results for non-mobile and mobile settings, in that perceived ease of using a mobile service significantly impacted perceived usefulness, which in turn significantly impacted adoption.

In recent technology adoption studies, dependent variables have been attitude [87], acceptance [82], preference, satisfaction [64, 65], intention [3, 35, 59], and actual use [15]. However, in their meta-analysis of online consumer behavior, Cheung et al. [16] stated: "compared to intention and adoption, continuance is an under-researched area." In particular, Flavián et al. stressed that loyalty (an indicator of continuance) is an important construct to consider for online studies. Our study is one of a first to consider loyalty within the mobile services domain. Our results show that both perceived usefulness and enjoyment significantly influenced m-loyalty.

Additionally, a hedonic component (enjoyment) was incorporated into the model; it has been suggested as being an important determinant of the adoption of mobile services.

Our results showed a larger path coefficient from enjoyment to m-loyalty than from usefulness to m-loyalty. To investigate further, effect sizes were calculated using the procedure outlined by Chin. The effect size of perceived usefulness and enjoyment on m-loyalty were f^2=0.17 and f^2=0.25, respectively. Cohen [19] provided the following criteria for interpreting effect size: (i) for small effect size, $0.02<f^2\leq0.15$; (ii) for medium effect size, $0.15<f^2\leq0.35$; and (iii) for large effect size, $f^2>0.35$. Although the path coefficient (*b*) and effect size (f^2) from enjoyment was larger than from perceived usefulness, both were classified as having a medium effect on m-loyalty. Therefore, our study showed that enjoyment may have at least as large an impact on loyalty as perceived usefulness. Van der Heijden found similar results in his study of portals and suggested that the function of the system or application under study affected the result. The mobile restaurant service used in our study had a strong entertainment and enjoyment functionality, and this may have contributed to a degree of enjoyment experienced by a user.

While the elements of our model have contributed to the theory and understanding of the mobile services domain, its primary contribution lies in the design aesthetics component. Despite the importance of usability and design for mobility [92], very few studies have addressed the topic. Our study demonstrated that design aesthetics do in fact have a significant impact on perceived usefulness, ease of use, and enjoyment. Tarasewich [85] suggested that aesthetics and usability may be an important part of "designing an overall enjoyable user experience with mobile devices." This was confirmed by our analysis, where design aesthetics may have a larger relative impact on enjoyment (*b*=0.55) than on usefulness (*b*=0.21) and ease of use (*b*=0.23). Our results also support Flavián et al., who suggested that usability elements do not follow a direct path to loyalty, but are mediated through other constructs that are antecedents to loyalty. In a post-hoc analysis, a PLS model was run to test a direct path between design aesthetics and m-loyalty. This was not significant (*b*=0.074; *p*>0.1) and the R^2 for m-loyalty was not improved (R^2=0.47).

From a theoretical perspective, the objective of our paper was to develop and validate a model for loyalty in a mobile domain. Our model built on a solid theoretical foundation and combined validated TAM constructs, a hedonic enjoyment construct, and design aesthetics in a new context (mobile services).

From a practitioner perspective, the objective of this paper was to provide practical insights into ways of establishing loyalty among users of mobile services. Depending on the nature of the service, enjoyment may play a critical role here. Accordingly, the design of the interface may be central in determining the level of enjoyment experienced by users, as well as the perceived usefulness and ease of use. For stationary devices, the interface has been demonstrated as significant to the success of the system [6]. To the end-user, the human-computer interface is often considered the most important component of the entire system [40]. It appears that the same is true for mobile devices. Our study proved that design aesthetics of the mobile interface can significantly impact important antecedents to loyalty.

Some limitations must, however, be considered. First, only one mobile service was investigated; it is entertaining and enjoyable and as such could impact participants' beliefs of usefulness and enjoyment on m-loyalty. Services that are more utilitarian by nature (such as mobile banking) may result in different relationships between the constructs of our model.

Second, this was a controlled laboratory experiment. However, laboratory experiments have flaws in terms of realism. The purpose of our research was to propose and test a model for perceived attractiveness of the interface design for a mobile product. Precision was essential for model validation. As such, a laboratory experiment was the most appropriate method.

Third, construct measures were collected at one point in time. Although the loyalty scales were based on previously validated constructs, one may argue that loyalty is difficult to measure using a series of questions following an initial experience with a system or product. True loyalty can only be demonstrated through repeated actions of preference.

Appendix A. Screen Shots

Numbers indicate different pages, or decks:

Appendix B. Summary of Cell Phone Functions

Joystick: the only tool you need to use to browse the CityGuide site today.

1. Move up and down to browse the site (the page scrolls only up and down).

2. Move left and right to highlight links. Move right to go to the next link, and move left to return to the previous link. A box will appear around these text links.

3. When the link is highlighted, push inward to click and advance to the next page. (Use the links at the bottom of pages to return to the main menu, or if you prefer, use the "Back" button on the keypad to go back a page.)

The **Main Menu** button: if you accidentally go to another application or window, click (do not hold) this button to return to the main application window, then use the Joystick to scroll back to the Opera browser.

Back button: if you prefer you can use this button to go back a page instead of clicking the "back" links in the site.

Appendix C. M-loyalty Survey

Following are the statement used in the survey**.** Each was answered on a 7-point Likert scale from strongly disagree to strongly agree.

Design Aesthetics
Sources: [21, 22, 90]
DA-1: The screen design (i.e. colors, boxes, menus, etc) is attractive.
DA-2: This site looks professionally designed.
DA-3: The graphics are meaningful.
DA-4: The overall look and feel of the site is visually appealing.

Perceived Usefulness
Sources: [8, 62]
PU-1: The service helped me be more effective.
PU-2: The service required the fewest steps to accomplish what I wanted to do with it.
PU-3: The service made the task I wanted to accomplish easier to get done.
PU-4: This service helped me be more productive.

Perceived Ease of Use
Sources: [50]
PEOU-1: Learning to use this service is easy for me.
PEOU-2: It would be easy for me to become skillful at using this service.
PEOU-3: I find this service easy to use.

Perceived Enjoyment
Sources: [8, 9, 14]
E-1: Using the service was exciting.
E-2: The process of using this service was pleasant.
E-3: It was cool to use.
E-4: I had fun using this service.
E-5: I found using this service to be enjoyable.

M-Loyalty
Sources: [21, 22]
L-1: I would use this mobile service again.
L-2: I would consider purchasing from this mobile service in the future.
L-3: I would consider using this mobile service in the future.

References

[1] A. Aarnio, A. Enkenberg, J. Heikkila, S. Hirvola, Adoption and use of mobile services empirical evidence from a Finnish survey, in: Proceedings of the 35th Hawaii International Conference on System Sciences, 2002.

[2] R. Agarwal, E. Karahanna, Time flies when you're having fun: cognitive absorption and beliefs about information technology usage, MIS Quarterly 24 (4), 2000, pp. 665–694.

[3] T. Ahn, S. Ryu, I. Han, The impact of the online and offline features on the user acceptance of Internet shopping malls, Electronic Commerce Research and Applications 3, 2004, pp. 405–420.

[4] B. Anckar, D. D'Incau, Value creation in mobile commerce: Findings from a consumer survey, Journal of Information Technology Theory & Application 4 (1), 2002, pp. 43–64.

[5] R.E. Anderson, S.S. Srivanan, E-Satisfaction and e-loyalty: A contingency framework, Psychology and Marketing 20, 2003, pp. 123–138.

[6] H. Bidgoli, Designing a user-friendly interface for a decision support system, Information Technology 12(3), 1990, pp.148-154.

[7] S. Brewster, P. Cryer, Maximising screen-space on mobile computing devices, in: Proceedings of the Conference on Human Factors in Computing Systems (CHI'99), Pittsburgh, Pennsylvania, 1999.

[8] G. Bruner, A. Kumar, Explaining consumer acceptance of handheld Internet devices, Journal of Business Research 58, 2003, pp. 115-120.

[9] G. Bruner, K. James, P.J. Hensel, Marketing Scales Handbook: A Compilation of Multi-Item Measures, VIII, Chicago: American Marketing Association, 2001.

[10] M. Chae, J. Kim, H. Kim, H. Ryu, Information quality for mobile Internet services: A theoretical model with empirical validation, Electronic Markets 12(1), 2002, pp.38-46.

[11] S.S. Chan, X. Fang, J. Brzezinski, Y. Zhou, S. Xu, J. Lam, Usability for mobile commerce across multiple form factors, Journal of Electronic Commerce Research 3 (3), 2002.

[12] P.Y.K. Chau, P.J. Hu, Examining a model of information technology acceptance by individual professionals: An exploratory study, Journal of Management Information Systems 18(4), 2002, pp. 191-229.

[13] W.W. Chin, The partial least squares approach to structural equation modeling, in: G.A. Marcoulides (Ed.), Modern Methods for Business Research, Lawrence Erlbaum, Hillsdale, NJ, 1998.

[14] T. Childers, C. Carr, J. Peck, S. Carson, Hedonic and utilitarian motivations for online retail shopping behavior, Journal of Retailing 77, 2001, pp. 511–535.

[15] L. Chen, M. L. Gillenson, and D. L. Sherrell. Enticing online consumers: An extended technology acceptance perspective, Information & Management 39, 2002, pp 705-719.

[16] C. Cheung, L, Zhu, T. Kwong, G. Chan, M. Limayem, Online consumer behavior: A review and agenda for future research, Proceedings of the 16th Bled eCommerce Conference, 2003, pp. 194-218.

[17] J. Chung, F.B. Tan, Antecedents of perceived playfulness: An exploratory study on user acceptance of general information-searching websites, Journal of Information and Management 41, 2004, pp. 869–881.

[18] P. Chwelos, I. Benbasat, A.S. Dexter, Research report: Empirical test of an EDI adoption model, Information Systems Research 12, 2001, pp. 304-321.

[19] Cohen, J., Statistical Power Analysis for the Behavioral Sciences, 2nd Edition, 1988, New York: Academic Press.

[20] L. J. Cronbach, Test Validation. Educational Measurement, 2nd Edition, ed. R.L. Thorndike. 1971, Washington, D.C.: American Council on Education. pp. 443-507.

[21] D. Cyr, C. Bonanni, J. Bowes, J. Ilsever, Beyond trust: website design preferences across cultures, Journal of Global Information Management, 13(4), 2005, pp.24-52.

[22] D. Cyr, C. Bonanni, J. Ilsever, Design and E-loyalty across cultures in electronic commerce, in: Proceedings for the Sixth International Conference on Electronic Commerce (ICEC04), published by the Association for Computing Machinery (ACM), 2004.

[23] P.A. Dabholkar, R.P. Bagozzi, An attitudinal model of technology-based self-service: moderating effects of consumer traits and situational factors, Journal of the Academy of Marketing Science 30 (3), 2002, pp. 184–202.

[24] F. Davis, 1986, A Technology Acceptance Model for empirically testing new end-user information systems: theory and results, Doctoral Dissertation, Sloan School of Management, Massachusetts Institute of Technology.

[25] S. Devaraj, M. Fan, R. Kohli, R., Antecedents of B2C channel satisfaction and preference: Validating e-commerce metrics, Information Systems Research, September, 2002, pp. 316–333.

[26] A. Dillon, J. Richardson, C. McKnight, The effect of display size and text splitting on reading lengthy text from the screen, Behaviour and Information Technology 9(3), 1990, pp. 215–227.

[27] K. Dion, E. Bersheid, E. Walster, What is beautiful is good, Journal of Personality and Social Psychology 24(3), 1972, pp. 285–290.

[28] R.L. Duchnicky, P.A. Kolers, Readability of text scrolled on visual display terminals as a function of window size, Human Factors 25, 1983, pp. 683–692.

[29] S. Duda, Schiessl, J.M. Hess, Mobile usability: Guidelines for the development of user friendly mobile services, in: M. Beier, V. von Gizycki, (eds), Usability—Nutzerfreundliches Web-Design, Berlin, Heidelberg: Springer-Verlag, 2002, pp. 173–199, accessed on March 5, 2005 at: http://www.eye-square.com/documents/mobile-usability-eyesquare-english.pdf

[30] X. Fang, S. Chan, J. Brzezinski, S. Xu, A study of task characteristics and user intention to use handheld devices for mobile commerce, in: Proceedings of the Second Annual Workshop on HCI Research in MIS, Seattle, WA, December 12–13, 2003.

[31] C. Flavián, M. Guinalíu, R. Gurrea, The role played by perceived usability, satisfaction and consumer trust on website loyalty, Information & Management, 2005, in press.

[32] C. Fornell and F. L. Bookstein, Two structural equation models: LISREL and PLS applied to consumer exit-voice theory, Journal of Marketing Research 19, 1982, pp. 440-452.

[33] C. Fornell and D. F. Larcker, Evaluating structural equation models with unobserved variables and measurement error, Journal of Marketing Research 18, 1981, pp. 39-50.

[34] J.J. Garrett, The Elements of User Experience: User-centered design for the web, Indiana: New Riders Publications, 2003.

[35] D. Gefen, E. Karahanna, and D. W. Straub. Trust and TAM in online shopping: An integrated model, MIS Quarterly 27(1), 2003, pp 51-90.

[36] D. Gefen, D.W. Straub, Managing user trust in B2C e-Services, e-Service Journal 2(2), 2003, pp.7-24.

[37] D. Gefen, D. W. Straub, and M.C. Boudreau, Structural equation modeling and regression: Guidelines for research practice, Communications of the Association for Information Systems 4(7), 2000, pp. 2-77.

[38] M. Gommans, K.S. Krishan, and K.B. Scheddold, From brand loyalty to e-loyalty: A conceptual framework, Journal or Economic and Social Research 3(1), pp. 43-58.

[39] J. F. Hair, et al., Multivariate Data Analysis with Readings, 4th ed. 1995, Englewook Cliffs, NJ: Prentice-Hall.

[40] M. Head, User Interface Features: Facilitating Information Access and Decision Making. Information Systems, Ph.D. Thesis, McMaster University, 1997, 228 pages.

[41] L.E. Holmquist, Will baby faces ever grow up? in: H.-J. Bullinger, J. Ziegler (eds.): Ergonomics and User Interfaces, HCI International Conference Proceedings 1, Munich, Germany, 22–26 August, 1999, pp. 706–709.

[42] Z. Jiang, I. Benbasat, The effects of interactivity and vividness of functional control in changing web consumers' attitudes, in: Proceedings for the Twenty-Fourth International Conference on Information Systems, Seattle, 2003.

[43] M. Jones, G. Marsden, N. Mohd-Nasir, K. Boone, G. Buchanan, Improving web interaction on small displays, accessed on February 4, 2005, at http://www8.org/w8-papers/1b-multimedia/improving/improving.html.

[44] E. Kaasinen, M. Aaltonen, J. Kolari, S. Melakoski, T. Laakko, Two approaches to bringing Internet services to WAP devices, Computer Networks: The International Journal of Computer and Telecommunications Networking 33 (1–6), 2000.

[45] K. Karvonen, The beauty of simplicity, ACM Proceedings on the Conference on Universal Usability, http://doi.acm.org/10.1145/355460.355478, 2000, pp. 85–90.

[46] F. N. Kerlinger, Foundations in Behavioral Research. 1964, New York, NY: Holt, Rinehart, and Winston.

[47] H. Kiljander, J. Jarnstrom, User interface styles, In: C. Lindholm, T. Keinonen, H. Kiljander (eds), Mobile usability: How Nokia changed the face of the mobile phone, McGraw Hill, 2003, pp. 15–44.

[48] K. Kim, J. Kim, Y. Lee, M. Chae, Y. Choi, An empirical study of the use contexts and usability problems in mobile Internet, in: Proceedings of the 35th Annual Hawaii International Conference on System, Sciences, Los Alamitos, CA: IEEE Computer Society Press, 2002.

[49] M. Kleijnen, K. de Ruyter, M. Wetzels, Consumer adoption of wireless services: Discovering the rules, while playing the game, Journal of Interactive Marketing 18(2), 2004, pp.51-61.

[50] M. Koufaris, Applying the technology acceptance model and flow theory to online consumer behavior, Information Systems Research 13 (2), 2002, pp. 205–223.

[51] S. Kumar, C. Zahn, Mobile communications: Evolution and impact on business operations, Technovation, 23(6), 2003, pp. 515–520.

[52] M. Kuroso, K. Kashimura, Apparent usability vs. inherent usability, in: CHI '95 Conference Companion, Conference on Human Factors in Computing Systems, Denver, Colorado, 1995, pp. 292–293.

[53] T. Lavie, N. Tractinsky, Assessing dimensions of perceived visual aesthetics of web sites, International Journal of Human-Computer Studies 60 (3), 2004, pp. 269–298.

[54] J. Lee, J. Kim, J. Moon, What makes Internet users visit cyber stores again? Key design factors for customer loyalty in: Proceedings of the Conference on Human Factors in Computing Systems CHI 2000, ACM, New York, 2000, pp. 305–312.

[55] Y. Lee, I. Benbazat, Interface design for mobile commerce, Communications of the ACM 46 (12), 2003.

[56] P. Legris, J. Inghan, P. Collerette, Why do people use information technology? A critical review of the technology acceptance model, Information & Management (40) 2003, pp. 191–204.

[57] H. Lin, Y. Wang, An examination of the determinants of customer loyalty in mobile commerce contexts, Information & Management 43, 2006, pp.271-282.

[58] C. Lindholm, T. Keinonen, H. Kiljander, Mobile usability: How Nokia changed the face of the mobile phone, McGraw Hill, 2003, p. 12.

[59] C. Liu, J. Marchewka, J. Lu, C. Yu, Beyond concern: a privacy–trust–behavioral intention model of electronic commerce, Information & Management 42, 2004, pp.127-142

[60] G. Loshe, P. Spiller, Internet retail store design: how the user interface influences traffic and sales, Journal for Computed-Mediated Communication 5(2), 1999, http://www.ascusc.org/jcmc/vol5/issue2/lohse.htm.

[61] P. Luarn, H. Lin, Toward an understanding of he behavioral intention to use mobile banking, Computers in Human Behavior 21, 2005, pp.873-891.

[62] A. Lund, Introduction to USE, Human Factors and Ergonomics Society: Communications Technical Group Newsletter, Winter, 1999, pp. 10–13.

[63] A. Marcus, Babyface design for mobile devices and the Web, in: M.J. Smith, G. Salvendy, (eds.) Systems, Social and International Design Aspects of Human-Computer Interaction, HCI International Conference Proceedings 2, New Orleans, USA, 5–10 August, Lawrence Erlbaum Associates, 2001, pp. 714–718.

[64] M. Mahmood, J. Burn, L. Gemoets, C. Jacquez, Variables affecting information technology end-user satisfaction: a meta-analysis of the empirical literature, Int. J. Human-Computer Studies 52, 2000, pp.751-771

[65] V. McKinney, K. Yoon, F. Zahedi, The measurement of web-customer satisfaction: An expectation and disconfirmation approach. Information Systems Research 13(3), pp. 296-315

[66] S. Mithas, N. Ramasubbu, M.S. Krishnan, C. Fornell, Effect of website characteristics on consumer loyalty: A multilevel analysis, in: Proceedings of the Twenty-Fourth International Conference on Information Systems, 2003.

[67] J. Moon, Y. Kim, Extending the TAM for a World-Wide-Web context, Information and Management 38, 2001, pp. 217–230.

[68] M. Nakayama, An assessment of EDI use and other channel communications on trading behavior and trading partner knowledge, Information & Management 40, 2003, pp. 563–580

[69] J. C. Nunnally, Psychometric Theory 2nd ed. 1978, New York: McGraw Hill.

[70] H. Nysveen, P.E. Pedersen, H. Thorbjørnsen, H., Intentions to use mobile services: Antecedents and cross-service comparisons. To appear in Journal of the Academy of Marketing Science 33(4), 2005.

[71] M. Pagani, Determinants of adoption of third generation mobile multimedia services, Journal of Interactive Marketing 18(3), 2004, pp.46-59.

[72] P.E. Pedersen, Adoption of mobile Internet services: An exploratory study of mobile commerce early adopters. To appear in Journal of Organizational Computing and Electronic Commerce 15(2), 2005.

[73] M. Perry, K. O'Hara, A. Sellen, R. Harper, B.A.T. Brown, Dealing with mobility: understanding access anytime, anywhere, Transactions on Computer-Human Interaction, 2001.

[74] J.F. Resiel, B. Shneiderman, Is bigger better? The effects of display size on program reading, in: G. Salvendy (ed.), Social, Ergonomic and Stress Aspects of Work with Computers, Elsevier Science Publishers, 1987, pp. 113–122.

[75] T. Rist, P. Brandmeier, Customizing graphics for tiny displays of mobile devices, in: Proceedings of Mobile HCI 2001: Third International Workshop on Human Computer Interaction with Mobile Devices, M.D. Dunlop, S.A. Brewster (eds), Lille, France, September, 2001.

[76] S. Rivard and S. Huff, Factors of success for end user computing. Communications of the ACM 31(5), 1988, pp. 552-561.

[77] D.E. Rosen, E. Purinton, Website design: Viewing the Web as a cognitive landscape, Journal of Business Research 57, 2004, pp. 787–794.

[78] S. Sarker, J. Wells, Understanding mobile handheld device and adoption, Communications of the ACM 46 (12), 2003.

[79] A. Schmidt, H. Schroder, O. Frick, WAP—designing for small user interfaces, in: Proceedings, Conference on Human Factors in Computing Systems (CHI'00), accessed February 4, 2005 at http://www.sapdesignguild.org/editions/edition1/wap-design1.asp

[80] G. Schrott, J. Gluckler, What makes mobile computer supported cooperative work mobile? Towards a better understanding of cooperative mobile interactions, International Journal of Human Computer Studies 60, 2004, pp. 737–752.

[81] L. Schultz, Effects of Graphical Elements on Perceived Usefulness of a Library, accessed February 4, 2005, at: http://www.tarleton.edu/~schultz/finalprojectinternetsvcs.htm

[82] H.P. Shih, An empirical study on predicting user acceptance of e-shopping on the Web, Information & Management 41, 2004, pp 351-368.

[83] B. Shneiderman, User interface design and evaluation for an electronic encyclopedia, in: G. Salvendy, (ed.): Cognitive Engineering in the Design of Human-Computer Interaction and Expert Systems, Elsevier Science Publishers, 1987, pp. 207–223.

[84] D. W. Straub, Validating instruments in MIS research, MIS Quarterly 12(2), 1989, pp. 147-170.

[85] P. Tarasewich, Designing mobile commerce applications, Communications of the ACM 46 (12), 2003.

[86] P. Tarasewich, Wireless devices for mobile commerce: User interface design and mobility, in: B. Mennecke, T.J. Strader, (eds), Mobile Commerce: Technology, Theory, and Applications, Hershey, PA: Idea Group Publishing, 2002, pp. 26–50.

[87] H. Teo, L. Oh, C. Liu, and K. Wei, An empirical study of the effects of interactivity on web user attitude, International Journal of Human-Computer Studies 58, 2003, pp 281-305.

[88] N. Tractinsky, Toward the study of aesthetics in information technology, in: Proceedings Twenty-Fifth International Conference on Information Systems, 2004, pp. 771–780.

[89] N. Tractinsky, Aesthetics and apparent usability: Empirically assessing cultural and methodological issues, in: Proceedings of the SIGCHI conference on Human Factors in Computing Systems, Atlanta, Georgia, United States, 1997, pp. 115–122.

[90] H. van der Heijden, Factors influencing the usage of websites: The case of a generic portal in The Netherlands, Information & Management 40 (6), 2003, pp. 541–549.

[91] V. Venkatesh, V. Ramesh, Usability of web and wireless sites: Extending the applicability of the Microsoft usability guidelines instrument, Information Systems Technical Reports and Working Paper, September, 2002, accessed on February 2005 at: www.kelley.iu.edu/ardennis/wp/.

[92] V. Venkatesh, V. Ramesh, A.P. Massey, Understanding usability in mobile commerce, Communications of the ACM 46, (12), 2003, pp. 53–56.

[93] J. Webster, J. J. Martocchio, Microcomputer playfulness: Development of a measure with workplace implications, Management Information Systems Quarterly 16 (2), 1992, pp. 201–226.

[94] J. Wu, S. Wang, What drives mobile commerce? An empirical evaluation of the revised technology acceptance model, Information & Management 42, 2004, pp. 719-729.

[95] B.H. Wixom, H. Watson, An empirical investigation of the factors affecting data warehousing success, MIS Quarterly 25(1), 2001, pp. 17–41.

[96] K. Yang. Exploring factors affecting the adoption of mobile commerce in Singapore, Telematics and Informatics 22, 2005, pp. 257–277

[97] S. J. Yoon, The antecedents and consequences of trust in online-purchase decisions, Journal of Interactive Marketing 16 (2), 2002, pp. 47–63.

[98] P. Zhang, N. Li, Love at first sight or sustained effect? The role of perceived affective quality on users' cognitive reactions to IT, in: Proceedings of the Twenty Fifth International Conference on Information Systems, 2004.

[99] W. Zhu , F. Nah , F. Zhao, Factors influencing users' adoption of mobile computing, In Mariga, J. (Ed.), Managing e-commerce and mobile computing technologies, Idea Group Publishing, Hershey, PA, 2003, pp. 260-271

[100] K. Zimmerman, Cell phone tunes ring in profits as users pick hits, accessed March 5, 2005 at: http://www.zingyinc.com/pressclippings/20040313_chicagotribune.html

Table 1.
Participant Demographics

Age	Range: 19 to 56 years; Average: 32
Gender	Women: 51.6%; Men: 48.4%
Highest level of education	High school (33%) Technical degree (6%) Undergraduate / College (50%) Masters / Doctorate (15%)
Time spent online per week	19.7 hours
Internet experience	84%
Mobile Internet browsing experience	19%
Time owned a cell phone	4.6 years
Use of the mobile Internet	Buy movie/concert tickets (67%) Download games/ring tones (48%) Browse places to eat or shop (41%) Check news (40%) Other (12%l)

Table 2.
Principle Components Factor Analysis

Items	Design Aesthetics	Perceived Ease of Use	Perceived Usefulness	Enjoyment	M-Loyalty
DA-1	0.79				
DA-2	0.88				
DA-3	0.72				
DA-4	0.84				
PEOU-1		0.87			
PEOU-2		0.88			
PEOU-3		0.71			
PU-1			0.81		
PU-2			0.73		
PU-3			0.77		
PU-4			0.73		
E-1				0.72	
E-2				0.77	
E-3				0.89	
E-4				0.88	
E-5				0.79	
L-1					0.79
L-2					0.74
L-3					0.78
Cronbach α	0.89	0.87	0.85	0.94	0.83

Note: Only loadings > 0.5 are shown.

Table 3**.**
Discriminant Validity of Constructs

	Design Aesthetics	Perceived Ease of Use	Perceived Usefulness	Enjoyment	M-Loyalty
Design Aesthetics	**0.81**				
Perceived Ease of Use	0.23	**0.82**			
Perceived Usefulness	0.32	0.57	**0.76**		
Enjoyment	0.61	0.39	0.36	**0.81**	
M-Loyalty	0.44	0.45	0.53	0.59	**0.77**

The diagonal elements in bold (the square root of average variance extracted) should exceed the inter-construct correlations below and across them for adequate discriminate validity.

Table 4**.**
Results of Hypotheses Testing

Hypothesis	Causal path	Path coefficient	*t*-Values	Supported
H1	Design Aesthetics → PU	0.21	2.14*	Yes
H2	Design Aesthetics → PEOU	0.23	1.96*	Yes
H3	Design Aesthetics → Enjoyment	0.55	4.97***	Yes
H4	PEOU → PU	0.52	4.43***	Yes
H5	PEOU → Enjoyment	0.26	2.27*	Yes
H6	PU → M-Loyalty	0.37	3.54***	Yes
H7	Enjoyment → M-Loyalty	0.46	3.39***	Yes

Figure 1. A Model for Design Aesthetics and M-Loyalty

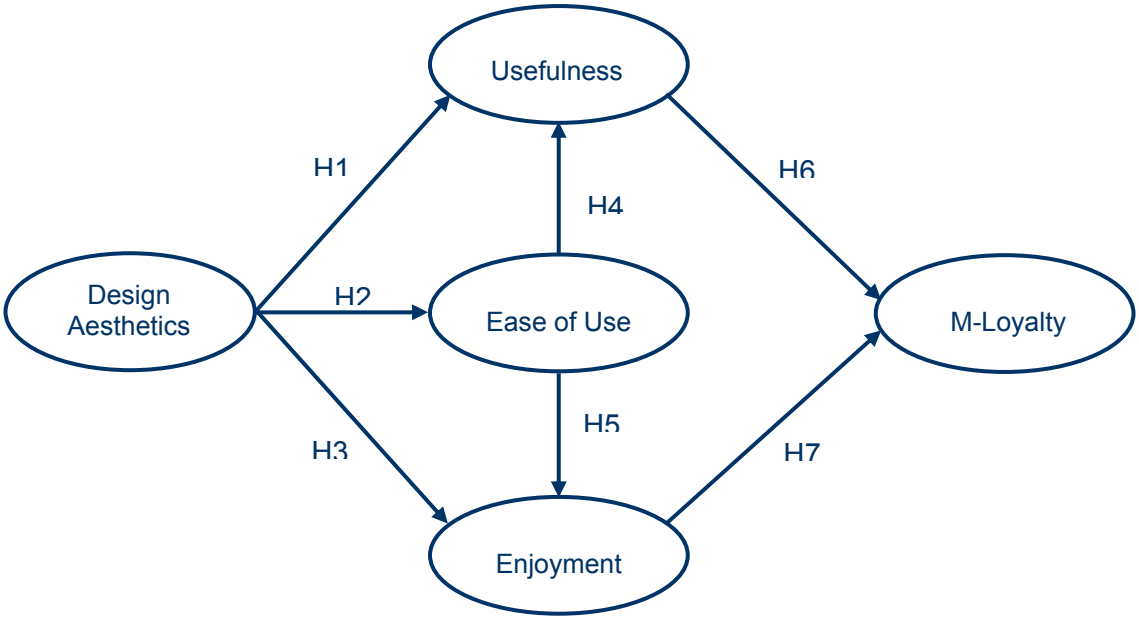
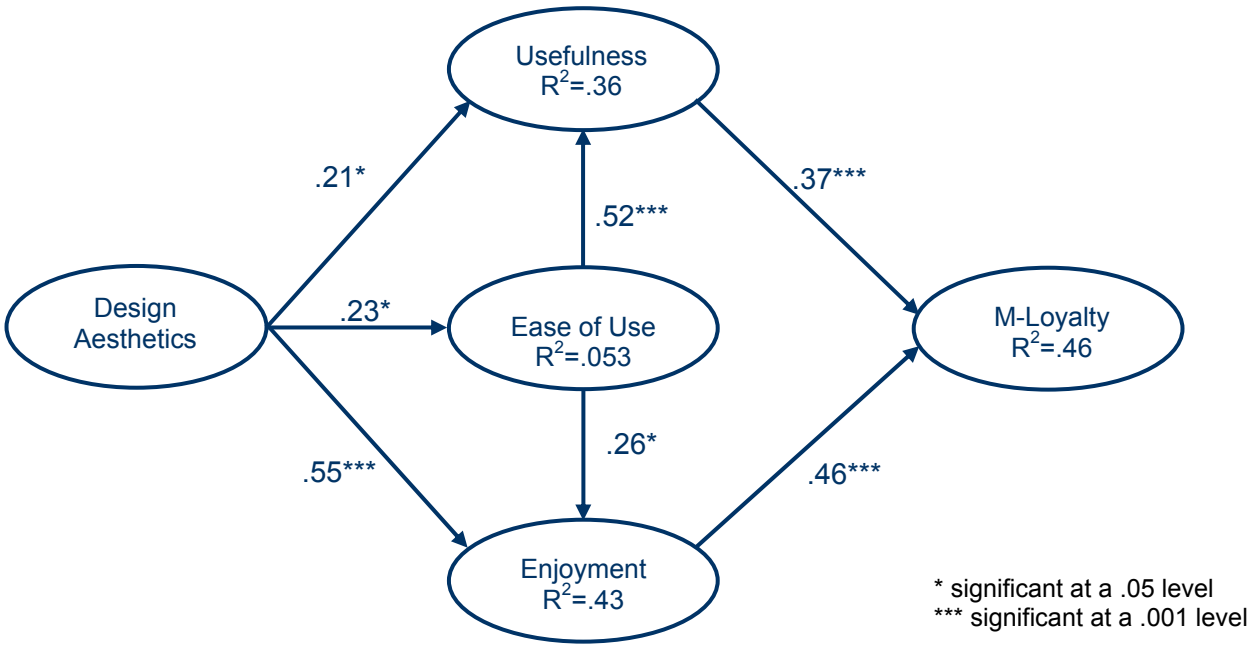


Figure 2. PLS Structural Model



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Dr. Dianne Cyr is an Associate Professor in the Faculty of Business at Simon Fraser University in Vancouver. She is leading a government funded research project titled "Managing E-loyalty through Experience Design". This investigation is focused on how trust, satisfaction, and loyalty are built in online business environments through website design. Unique features of this work are comparisons across cultures, genders, and concerning applications to mobile devices. Further details of these research projects may be accessed at www.eloyalty.ca Dianne Cyr is the author of five books and over 50 research articles. Career information may be found at www.diannecyr.com

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