JITTA

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

A Publication of the Association for Information Systems

Design Features Impacting Mobile Phone Upgrading Frequency

Maria Sääksjärvi
Department of Product Innovation Management
Delft University of Technology
m.c.saaksjarvi@tudelft.nl

Katarina Hellén
Department of Marketing
University of Vaasa
katarina.hellen@uva.fi

Tuure Tuunanen
Department of Computer Science and Information Systems
University of Jyväskylä
tuure@tuunanen.fi

Abstract:

This study examines the impact of design on customer upgrading frequency, and differentiates between functional and aesthetic aspects of design. For the empirical study, we conducted an intercept survey in Beijing and Shanghai with Chinese consumers (n=170) in a retail mall setting. The survey's results suggest that the functional design aspects of mobile phones (screen size, keyboard, and width of body) affect perceived ease of use, and that design aesthetics (color and thickness of body) moderate the relationship between satisfaction and upgrading frequency. However, we did not gain significant results for the relationship between functional design and perceived usefulness. The results provide initial evidence of the importance of design for consumers when upgrading their mobile phones. The findings highlight the need to further investigate the impact of design.

Keywords: Upgrading Frequency, Design, Aesthetic Design, Functional Design, Mobile Phones.

Volume 15, Issue 1, pp 33-47., March 2014

Marcus Rothenberger acted as the Senior Editor for this paper.

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

INTRODUCTION

The technological boom in the beginning of the 21st century produced radically new products that changed the way people communicate and interact with each other. This was particularly the case with mobile phones, which have evolved from simple communication devices to multiplex innovations whose new features (such as picture messages, cameras, apps along with features such as being smaller). One important topic for the mobile phone industry is consumer upgrading of mobile phones. The global penetration rate of mobile phones in 2013 was 96.2 percent of the population (http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx), meaning that most people own a mobile phone and thus one could argue that the mobile phone market is saturated and that the only way organizations can make profit is by convincing customers to upgrade their phones. In other words, upgrading is a significant part of many companies' revenue (Okada, 2006). At the same time, many technology companies face harsher competition and have difficulties finding a competitive edge. Because we can argue that the radical technological innovative period has passed and that the mobile phone market is relatively matured, companies will find it increasingly more difficult to convince consumers to upgrade their products (Okada, 2001; Shih & Schau, 2001).

In this paper, we argue that, in the mobile phone industry, design can play a significant role in how frequently consumers upgrade their mobile phones. We refer to "frequency of upgrading" here as the rate at which consumers replaces their product in a specific product category. Design is particularly important in the mobile phone industry because companies are looking for new ways to differentiate themselves from the competition, and design offers an avenue for achieving this goal because product differentiation through the existing mobile service platforms is becoming increasingly difficult. Indeed, contemporary mobile service platforms (Tuunainen & Tuunanen, 2011; Tuunainen, Tuunainen, & Piispanen, 2011), such as Apple's App Store and Google's MarketPlace, offer millions of different apps and services. These mobile service platforms enable consumers to enjoy similar mobile services across all platforms. For example, many of the popular apps are available on all popular mobile service platforms (e.g., the Angry Birds game from Rovio or the Spotify music service are available on all phones that run Apple iOS and Android operating systems—the vast majority of mobile phones today). To this end, content differentiates mobile phones less than it used to and a product's visual appeal might become more important.

In this paper, we investigate how mobile phones' design affects upgrading frequency by taking into account the perceived ease of use, usefulness, and satisfaction of customers' current mobile phone. Following Veryzer (1995), we differentiate between functional and aesthetic design. We use functional design refers to a product's configuration, which communicates the product's use and operating procedure to the consumer. We use aesthetic design to refer to a product's characteristics that are visually pleasing. We propose that a mobile phone's functional design elements (body width, screen size, and keyboard) significantly influence perceived usefulness and ease of use, which, in turn, influence satisfaction. Furthermore, we propose that aesthetic design (color and body thickness) positively moderates the relationship between satisfaction and upgrading frequency.

This paper is structured as follows: the theoretical background section reviews the literature on upgrading frequency

CONTRIBUTION

This study contributes to the literature by showing that design plays an important part of upgrading frequency, and that functional and aesthetic design elements have a differential impact on upgrading frequency. More specifically, our findings show that design variables can help to predict upgrading behavior. Whereas previous research has largely focused on technological advancement as a predictor for upgrading decisions, we argue for including functional and aesthetic design as predictors. Our findings demonstrate that the functional design aspects increase customer satisfaction, but aesthetic aspects such as color and thickness of body to affect positively to consumers' upgrading frequency. Also, aesthetic design seems to enhance the relationship between satisfaction and upgrading frequency, making aesthetic design an important component; although consumers are satisfied with their current phone, they may still upgrade for aesthetic reasons.

The study contributes to practice in several ways. First of all, practitioners should focus on different design aspects depending on whether they want to increase consumers' upgrading behavior or perceived ease of use. In order to increase perceived ease of use, firms should design phones that have a large screen, fewer visible buttons, and a relatively narrow body. Furthermore, our results indicate that in order to increase upgrading frequency, firms should carefully consider of using colors other than gray, black, and white and emphasize thinness of the phones.

and design literature, and includes the hypotheses that we tested. The methods section presents the conducted study. The results section overviews the findings, and the discussion section discusses the study's findings, implications, and limitations.

THEORETICAL BACKGROUND

In this section, we review the product upgrading literature and design literature. We present a proposed model that integrates design, experiences with current products, upgrading frequency, and discuss how we developed our hypotheses.

Upgrading frequency

A firm's customers can be divided into two groups: customers who purchase a product from a specific product category for the first time, and customers who already own a product from that category but have decided to replace their old product by upgrading it with a newer version (Shih & Schau 2011). Although researchers have typically focused on new buyers, they have provided arguments suggesting that upgrading comprises an important part of firm revenue (Okada, 2006). Customer upgrading can even be seen as necessary for survival, especially in markets that are relatively saturated, such as the mobile phone industry. Thus, it is in firms' interest to increase customers' upgrading frequency.

Previous research has documented that customers use different psychological models when they purchase a product for the first time compared to when they upgrade an existing product. Okada (2001, 2006) argues that, in general, consumers are reluctant to upgrade their products because, most often, the old product is still functioning, and replacing a product that still works fine is mentally perceived as a cost since the old product's value has not been used to its fullest. Therefore, upgrades are easily constructed as losses in the consumer's mind (Okada, 2001) and increasing consumers' mobile phone upgrading frequency is accordingly challenging.

The literature on upgrading has proposed different strategies that firms can employ in order to convince consumers to upgrade their products. Okada (2006) documents that consumers are more likely to upgrade their current product with a new one if the two are perceived as very dissimilar. Moreover, it seems like consumers are more willing to upgrade if the product is perceived to have only a few but new features, as opposed to enhanced, features. Somewhat conflictingly with these findings, Shih and Schau (2011) found that hedonic arguments supporting upgrading are more effective than technological arguments since the former makes consumers anxious about new possible improvements in technological features, which, in turn, makes them delay their upgrading decisions. In conclusion, emphasizing technological features is associated with both positive effects on upgrading (Okada, 2006) but also negative effects since it might cause consumers to wait for even more superior technological advancements (Shih & Schau 2011). Thus, a marketing strategy focusing on technological advances is not likely to come without risks. In this paper, we consider other product aspects that are likely to impact upgrading frequency. Drawing on Okada's (2006) findings that dissimilarity makes consumers more likely to upgrade their products, we propose that design will increase upgrading frequency.

Design

Visual product design refers to a product's external visible features (Berkowitz, 1987; Bloch, 1995; Talke et al., 2009; Sewall, 1978). In a broader sense, design encompasses both functional design (i.e., how an object's elements are organized) and aesthetic design (i.e., a product's shape and/or color) (Veryzer, 1995). Product design plays a growing role as a determinant of consumer behavior, especially for technology products. Companies produce products whose features are similar and thus need design to differentiate their products from those of their competitors (Berkowitz, 1987; Bloch, 1995). Design provides several commercial benefits for companies. For instance, design can improve customers' evaluation of (and satisfaction with) a product (Berkowitz, 1987; Tractinsky, Katz, & Ikar, 2000), foster continuity in a firm's product line, and draw attention to a firm's new products (Person et al., 2007).

Moreover, a product's design influences how consumers initially view it and therefore how they perceive its characteristics such as power, sophistication, softness, genuineness, and comfort (Mugge, Govers, & Schoormans, 2009). Product design also helps consumers to categorize the product as a luxury, commodity, or novelty product (Bloch, 1995; Warlop, Ratneshwar, & van Osselaer, 2005). According to Yalch and Brunel (1996), products with unique and innovative designs can help consumers satisfy their need for acceptance by a certain group and to differentiate themselves from others. Thereby, design helps consumers satisfy their social needs.

The literature on design generally differentiates between functional and aesthetic design (Person et al., 2007; Veryzer, 1995). Functional design is associated with engineering, but also involves usability and perceived ease of use (Veryzer, 1995). Veryzer (1995) argues that design helps consumers to explain the value and usage of

technically complicated products. According to Veryzer, this facet of design is of growing importance because people interact with complex technology on a daily basis. Therefore, from an operational point of view, products need to be designed to facilitate product understanding.

Aesthetic design refers to a product's visual identity. Firms often aim to create distinct visual identifies for a new product or a family of products in order to create aesthetic and/or symbolic implications (Bloch, 1995; Crilly, Moultrie, & Clarkson, 2004; Veryzer, 2000). Aesthetic considerations, such as shape, symmetry, and texture, have also increased in importance as companies introduce products that are relatively similar (Veryzer, 1995).

In this study, following Talke et al. (2009), we classify a mobile phone's screen size, keyboard design, and body width as functional design aspects. Today, people use mobile phones for much more than just making phone calls; these devices enable other types of interaction, such as reading and writing emails, browsing the Internet, navigating, listening to music, and watching television and movies. Since mobile phones today often include all these functional elements, the size of the screen in relation to the body, the keyboard, and the width of the body constitute functional design elements of mobile phones. The aesthetic elements of design include the color and thickness of body. The color of a mobile phone does not have any functional effects on the phone. In design terms, body thickness is both functional and aesthetic. As consumers associate thinness with state-of-the-art technology, the mobile phone industry tends to produce thinner devices that do not necessarily feature higher functionality (Ermolov et al. 2007). Because thinness in itself does not improve the functionality of the phone, we proposes that thinness is an aesthetic dimension of phone design. Table 1 summarizes the two design dimensions and their features and definition/categorization.

Table 1. Design dimensions and definitions

Dimension	Design feature	Definition and categorization
Functional design	Screen size	• Relative proportion of the screen size in comparison to the frontal body of the mobile phone. • Five categories are used to classify the screen size: 0/100, 25/100, 50/100, 75/100 and 100/100 screen display of the front of the mobile phone.
	Body width	• Proportion of length relative to width. • Two categories classify width of body: *1) Wide* phones' heights in relation to width are below the average proportions (.473) of the sample. *2) Long* phones' heights in relation to width are beyond the average proportions (.473).
	Keyboard	• The buttons that allow usage of the mobile phone. • Three categories classify the design of the keyboard: *1) Original* keyboards contain all the buttons on the frontal body of the mobile phone. *2) Basic* keyboards contain some of the buttons on the front of the body of the mobile phone but the keyboard numbers are hidden (so-called slider action keyboard). *3) Hidden* keyboards refer to models where no buttons are on display on the front of the phone and where all buttons are hidden or it has a virtual keyboard. • Note that for basic and hidden keyboards the user needs to open the phone in order to access buttons.
Aesthetic design	Color	• The color that covers the majority of the phone's frontal body. • Two categories are used to assess the color: *1) Traditional* colors refer to colors that have traditionally been used on mobile phones, i.e. black, grey, white and silver. *2) Colorful* colors refer to all colors other than traditional colors, such as for example, different shades of red, blue, pink, orange and green.
	Body thickness	• The thickness of the mobile phone in millimeters (mm). • Two categories are used to assess the thickness of body: *1) Thick* phones were thicker than the mean thickness (μ=18.74) of the phones in the sample. *2)Thin* phones were thinner than the average of the sample.

Hypotheses Development

Figure 1 shows the proposed model. In short, it illustrates that functional design positively affects a mobile phone's perceived ease of use and usefulness. Perceived ease of use and usefulness is in turn positively related to satisfaction with the mobile phone, and the positive relationship between satisfaction and repurchase intention is positively moderated by aesthetic design. We partly embed this model in the theory of technology acceptance (TAM) (Davis, Bagozzi, & Warshaw, 1989) to bring robustness to our predictions. The TAM was originally developed to explain how employers will adapt technological systems (Davis et al., 1989), but it has been used broadly across a range of different contexts (Huang, Lin, & Chuang, 2007; Wu & Wang, 2005). Furthermore, researchers have extended, borrowed, and also redefined TAM concepts and ideas to fit different research purposes (Lee et al., 2003). We do the same. Since studies on product upgrading imply that usage of current products is an important ingredient in understanding upgrading decisions (Okada, 2006), we test perceived ease of use and usefulness in the proposed model. Also, drawing on findings in the upgrading literature showing that satisfaction can help to explain upgrading (Okada, 2001), we include a measure of satisfaction in the model.

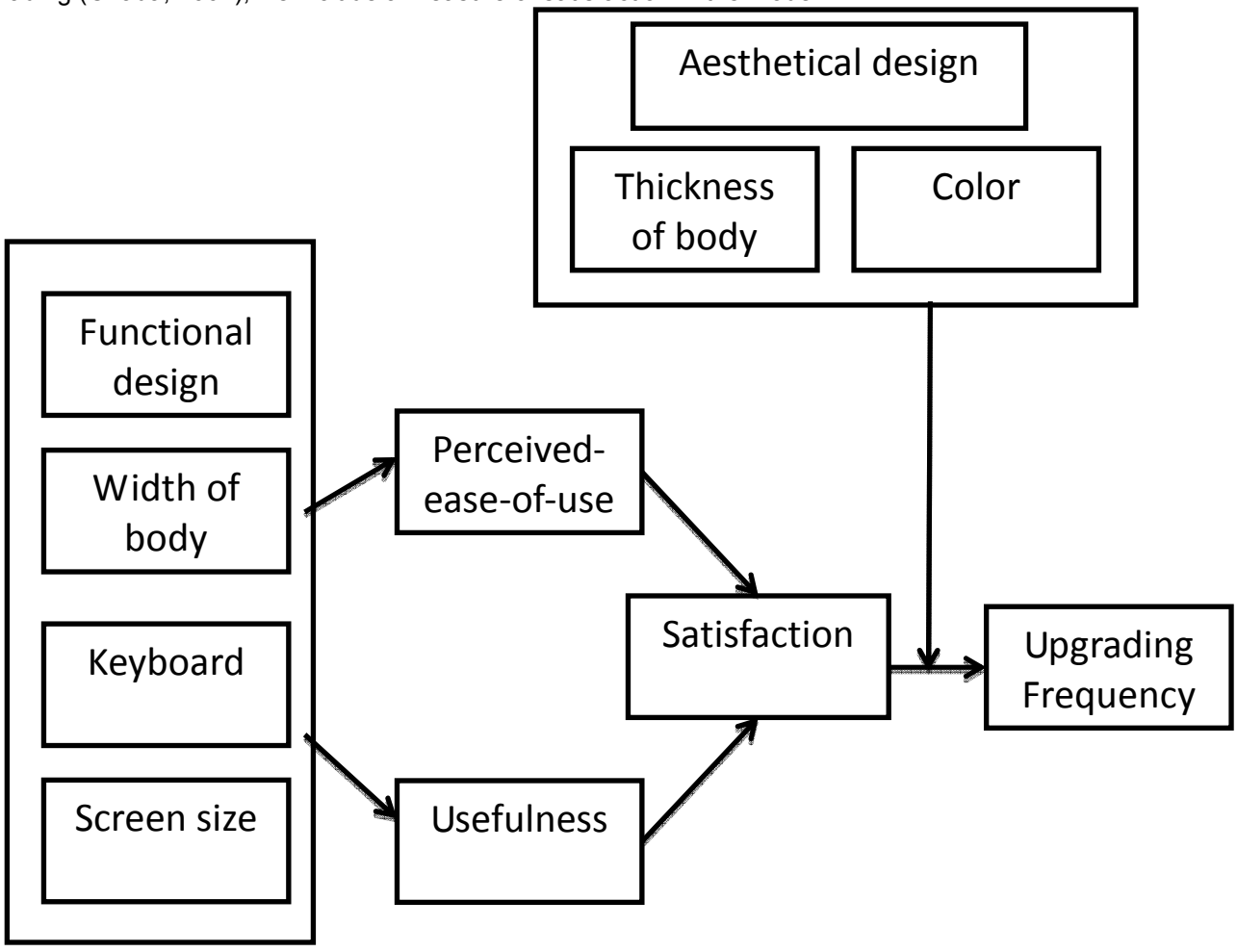

Figure 1. Proposed model of the role of design for upgrading

Functional design

The model proposes that functional design has a positive association with perceived usefulness and ease of use. More specifically, it considers the hypothesis that consumers perceive that the following types of mobile phones are useful and easy to use: a mobile phone with a large screen relative to the body, a phone that is relatively more narrow than wide, and phones with a hidden or displayed keyboard. Such relationships likely occur for several reasons.

Firstly, mobile phone designers have experimented with screen size as mobile phones' role has evolved from simply making phone calls to performing other activities, such as browsing the Internet and watching movies (Chae & Kim, 2004; Lindholm, Keinonen, & Kiljander, 2003; Vadas, Patel, Lyons, Starner, & Jacko, 2006, Tuunainen, Tuunanen, & Bastek, 2009). A relatively large screen size in relation to the body of the phone is better suited to the interactive

Journal of Information Technology Theory and Application

functions that mobile phones offer today and thereby positively affects perceived usefulness and ease of use. A relatively large screen enables the consumer to comfortably read and interact with a phone (Chae & Kim, 2004).

Secondly, considering that mobile phones are used daily for a growing range of applications, consumers expect to be able to hold the phone comfortably while interacting with the screen. Mobile phone manufacturers frequently design mobile phones that are ergonomic and easy to use (Hirotaka, 2003). Phones that are relatively narrow (rather than wide) are likely to be easier to hold because they fit more comfortably in the palm of a hand. Consequently, consumers will perceive devices that are narrower in proportion to their length (as compared with phones that are relatively wider) as easier to use and more useful.

Thirdly, manufacturers have introduced more powerful applications, features, and functions that make mobile phones devices of more interactive communication (Lindholm et al., 2003). This trend places higher demands on mobile phone designers: in order to keep users satisfied, they need to design devices that are user-friendly in terms of providing interactive services (e.g., video, chatting etc.) but nevertheless small in size. Some people even claim that mobile phone designers are making some mobile phone models too small for ease of use. For example, Kurniawan, Nugroho, and Mahmud (2006) show usability problems associated with small buttons and small screens, simply because users find it hard to dial when the buttons are small and close to each other. Also, watching tiny screens might not be comfortable in the long run. For this reason, smart keyboard design is essential. The keyboard—that is, the set of buttons and their configuration—is likely to play a vital role in consumers' perceptions of a phone's ease of use and usefulness. Mobile phone manufacturers have introduced a variety to solutions to make keyboards easier to use. In some models, the keyboard is hidden within the phone (shell model), which allows the manufacturer to build in larger buttons that are easier to use, which should resolve problems with dialing and using the more powerful features and applications. More recently, touch screen keyboards have further emphasized the need to design functional keyboards (virtual or physical). Therefore, we propose:

H1: Functional design elements relate positively to perceived ease of use.
H2: Functional design elements relate positively to usefulness.

Bruner and Kumar (2005) show that usefulness and ease of use contributed to people's attitudes toward handheld devices. Other studies support this relationship (e.g., Chen, Yen, & Chen, 2009). Johnson and Hignite's (2000) findings show no direct relationship between usefulness and attitude. However, they focused on a student population, which may limit the applicability of their results. Also, anecdotal evidence would suggest that it is likely that perceived ease of use and usefulness is related to satisfaction with a product. Therefore, we propose:

H3: Perceived ease of use associates positively with satisfaction.
H4: Perceived usefulness associates positively with satisfaction.

Aesthetic design

The model proposes that aesthetic design (color and thickness of body) moderates the relationship between satisfaction and upgrading frequency. Aesthetic elements do not necessarily improve a phone's functionality. Instead, consumers are likely to buy aesthetic products simply to be unique or trendy or because they are bored and want change. Consequently, a new phone's aesthetic design may predict how often a consumer will upgrade their phone (Meyer, Zhao, & Han, 2008). More specifically, the owners of relatively thin and colorful mobile phones are likely to have a shorter cycle of upgrading because they may be prone to buying a new phone simply to show that they are trendsetters and are able to do so (Meyer et al., 2008). Notably, Okada's (2001, 2006) studies show that consumer upgrading is seldom due to their dissatisfaction with their current products (and such a reason would be highly unwanted because dissatisfied consumers are likely to switch brands). On the contrary, Okada (2001) reports that consumers who are satisfied with their products are more likely to upgrade than people who were dissatisfied. Therefore, a mobile phone's aesthetic design components have moderating effects on the link between satisfaction and upgrading. Firstly, color plays an important role in upgrading because colorful designs may become outdated more quickly than designs that use basic colors. Color is an important driver of upgrading that serves to attract customers' attention (Kimle & Fiore, 1992) and create interest in a product (Chamblee & Sandler, 1992). Secondly, phones are becoming slimmer. A phone's color and thinness may influence rate of upgrading irrespective of the owner's satisfaction with their old phone. People associate new colors and thinness with technological advances, which is important to consumers who want top-of-the-line phones that make them look up-to-date with market trends (Meyer et al., 2008). This outcome does not mean that these consumers are necessarily dissatisfied with their current phones. Therefore, we propose:

H5: Aesthetic design moderates the effect of satisfaction on upgrading frequency.

RESEARCH METHOD

We collected data for our study by recruiting a marketing research agency to carry out a mall intercept study in Beijing and Shanghai. The data was collected in the year 2009. During four days, a Chinese research team interviewed mall visitors who owned a mobile phone with more features than simply calling and texting. The consumers selected for the study owned mobile phones that had numerous features; the consumers could also perform a wide variety of functions on their phones other than making phone calls. The team selected consumers who owned phones that had more advanced features than just calling and texting because such consumers comprise a representative market group aware of the latest developments in the mobile phone market. Consumers who only own a very basic phone are not likely to be able to express opinions about usefulness and ease of use that would be of interest for mobile phone manufacturers. They may only use their products for a single function (such as making phone calls), which limits their understanding of the possibilities that mobile phones can provide. As such, we assembled a representative sample of mobile phone users who would be aware of market developments and have actual usage experience of advanced phone models. The interviews were conducted on Xujiahui and Sichuan Road. Of 250 people approached, 175 agreed to participate in the study. Of these 175 people, five did not own advanced mobile phones and were excluded.

Similarly to Talke et al. (2009), this study focuses on design based on the products that consumers already own. To assess the design of the mobile phones that people owned, in the first phase we asked the respondents to state their phone's brand, model, and color. The sample included a total of eighty different mobile phone models. In the second phase, we collected the design specifications of the phone models from the manufacturers' product information websites. Table 2 summarizes the design dimensions in this study. Table 2 shows that half of the phone models in the data had a screen that covers half of the front body of the phone. Roughly half of the phone models had a narrow body and half a wide body. Half of the phone models had a full keyboard on the front body. Slightly over half of the models were thick. Most of the phones came in a traditional color (black or gray).

Table 2. Descriptive statistics of design dimensions in the sample

Construct	Dimension	Category	No (%)
Functional design	*Screen size*	0/100	3.4%
		25/100	19%
		50/100	50%
		75/100	27.6%
		100/100	0%
	Body width	Long	49.1%
		Wide	50.9%
	Keyboard	Original	55.2%
		Basic	28.4%
		Hidden	16.4%
Aesthetic design	*Body thickness*	Thick	57.8%
		Thin	42.2%
	Color	Traditional	79.4%
		Colorful	20.6%

Scales

We measured perceived ease of use with a three-item, seven-point semantic differential scale adapted from Dellaert and Stremersch (2005) ("complex–simple", "learning intensive–not learning intensive", "difficult to use–easy to use"), and we measured perceived usefulness by following Moreau, Markman, and Lehmann (2001) and asking consumers to list the advantages of their phones. In line with Moreau et al. (2001), we formed the measure by numerically counting the advantages. We measured satisfaction using a seven-point, five-item scale adapted from Roehm and Sternthal (2001) with the items "like/dislike", "bad/good", "worth owning/not worth owning", "impressive/unimpressive", "high quality/low quality". Upgrading frequency is the rate of how often the consumer replaces their mobile phone, which we measured by asking consumers to state how many mobile phones they had owned ("How many mobile phones have you owned since you bought your first one (include the current one)?"). This measure captures the extent to which consumers upgrade their mobile phone. Past purchase behavior is one of the strongest indicators of future purchases (Sheppard, Hartwick, & Warshaw, 1988), and therefore serves as a proxy for how often consumers upgrade their phones.

Reflective and formative constructs

This study uses both reflective and formative constructs. Reflective measures is the default in IS literature: it refers to

Journal of Information Technology Theory and Application

the fact that the measurement items are a reflection of the construct (Petter, Straub, & Rai, 2007). This is the approach used in classical test theory and factor analysis models (Fornell & Bookstein, 1982). As Petter et al. (2007) point out, often, however, "many times…the nature of the construct is not reflective, but formative" (p. 623). Formative constructs define the construct rather than reflect it (Petter et al., 2007). Formative construct consists of separate components that measure different parts of the construct (Chin, 1998a, 1998b). To this end, they need not to co-vary with each other because each item is designed to tap into a different dimension that jointly make up the construct (Petter et al., 2007). In other words, formative constructs are multi-dimensional construct in which the subdimensions represent the construct. This study treats functional and aesthetic components as formative constructs because they define the construct rather than reflect it, and their dimensions measure different parts of the construct. Research has shown that different aspects of functional and aesthetic design make distinct contributions to the construct and need not co-vary with each other (Creusen & Schoormans, 2005; Talke et al., 2009). To this end, we consider the different components of design as formative, rather than reflective, constructs. Figure 1 shows the model as tested using partial least squares (PLS) analysis on the sample of 170 respondents. Table 3 contains the description of the respondents.

As Table 3 shows, half of the respondents were male and half were female; 35 respondents were between 18 and 25 years of age, 50 were between 26 and 34; 50 were between 35 and 44, and 35 were between 45 and 55. Most respondents had a college education (82/170) and earnt between 300,000 and 400,000 Renminbi (RMB) (approximately 48,000-64,000 U.S. dollars) per year.

Table 3: Sample description

Age	Gender	Education	Income (RMB)	Phone brand
18-25 (20.6%)	Male (85)	High school (15.9%)	- 300,000 (29.4%)	Nokia 49.6%
26-34 (29.4%)	Female (85)	College (48.2%)	300,001-400,000 (50.6%)	Motorola 11.9%
35-44 (29.4%)		University (34.1%)	400,001-500,000 (11.2%)	Sony-Ericsson 17.1%
45-55 (20.6%)		Higher education (1.75)	500,001-600,000 (4.1%)	Other 21.4%
			Above 600,000 (4.7%)	

Note: The number in brackets denotes the percentage of participants belonging to that group out of the total number of participants

RESULTS

We validated reflective indicators by checking the factor loadings, average variance extracted (AVE), and composite reliability. Table 4 shows the factor loading of each item. The individual item loadings presented in Table 4 show that all items had a load higher than .5 on their respective construct, which supports a high degree of individual item reliability (Hulland, 1999). To fulfil these criteria, we excluded one item from the ease of use construct. We used composite reliability to assess the internal consistency of items hypothesized to measure a single construct (Fornell & Larcker, 1981). The items measuring the constructs were internally consistent because all composite reliability values exceeded the .7 guideline that Nunnally and Bernstein (1994) suggest.

Table 5 lists the statistics on factor level: it shows correlations, composite reliability, AVE, and square-root values of AVE (bolded on the diagonal). We examined the convergent validity of the constructs by examining each construct's AVE (see Table 5). Because all AVE values were above .5, the convergent validity of the constructs used in this study is acceptable (Chin & Newsted, 1999). In addition, Table 5 compares each construct's squared AVE with the correlations of the constructs for discriminant validity (Fornell & Larcker, 1981). For all the constructs, the square of the AVE exceeded the correlation between the constructs. This result provides evidence for discriminant validity (Chin, 1998a).

For formative constructs, the interpretation is based on content validity (Petter et al., 2007). Because formative indicators need not be correlated, the loadings or reliability estimates of formative indicators provide no meaningful interpretation (Bollen, 1984; Bollen & Lennox, 1991; Chin, 1998b). To this end, the assessment of formative constructs is based on content validity; that is, is the construct captured as defined in the literature (Diamantopoulos & Winklhofer, 2001; Petter et al., 2007) and does its indicators lack multicollinearity (Diamantopoulos & Winklhofer, 2001; Petter et al., 2007). We define functional and aesthetic design per the existing literature (Creusen & Schoormans, 2005; Talke et al., 2009) and, as can be seen in Table 4, the correlation coefficients between the indicators were not subject to multicollinearity. This provides evidence for the validity of the formative constructs.

Table 4. Item loadings

Concepts	Items	Loading
Perceived ease-of-use	Easy to use	.87
	Learning intensive	.71
Satisfaction	Like/dislike	.77
	Bad/good	.84
	Worth owning/not worth owning	.74
	Impressive/unimpressive	.70
	High quality/low quality	.72

Table 5. Descriptive statistics on factor level

	(1)	(2)	(3)	(4)	(5)
(1) Functional design	**-**				
(2) Usefulness	.128	**.911**			
(3) Perceived ease-of-use	.199	.007	**.793**		
(4) Satisfaction	.081	.101	.466	**.922**	
(5) Aesthetic design	.094	.106	-.036	-.010	**-**
Composite reliability	-	.71	.77	.75	-
Average variance extracted	-	.83	.63	.85	-

**. Correlation is significant at the .001 level (2-tailed)
*. Correlation is significant at the .05 level (2-tailed)
Note: Square root values of average variance extracted are bolded on the diagonal.

Table 6 lists the results for the study.

Table 6. Results for the structural model

Relationship	β coeff.	p-value	T-value	Conclusion
Functional design ➔ Perceived ease-of-use	.199	.01	2.04	H1 supported
Functional design ➔ Usefulness	.128	ns.	.96	H2 not supported
Perceived ease-of-use ➔ Satisfaction	.466	.01	5.41	H3 supported
Usefulness ➔ Satisfaction	.098	.10	1.30	H4 marginally supported
Aesthetic design x Satisfaction ➔ Upgrading frequency	.806	.05	2.26	H5 supported

H1 states that functional design elements are positively related to perceived ease of use. Our results support H1: functional design elements had a positive association with perceived ease of use (β = .199, t = 2.04, p <.01). H2 postulates that functional design elements are positively related to usefulness. The data does not support this hypothesis; the path coefficient for functional design on usefulness was non-significant (p <.10). H3 states that perceived ease of use is positively associated with satisfaction. Our results support this hypothesis; perceived ease of use had a positive influence on satisfaction (β = .466, t = 5.41, p <.01). H4 postulates that perceived usefulness is positively associated with satisfaction. The data marginally support this hypothesis (β = .098, t = 1.30, p <.10). H5 states that aesthetic design moderates the effect of satisfaction on upgrading frequency. The data support this proposition (β = .806, t = 1.96, p <.05). Importantly, the data shows a positive moderating effect of design, which illustrates a quicker rate of upgrading for aesthetically pleasing phones. The main effects of satisfaction and aesthetics were also significant (satisfaction: β = .312, t = 2.05, p <.01); (aesthetics: β = .952, t = 2.26, p <.01).

DISCUSSION

Customers upgrading their mobile phones comprise an important segment for the saturated mobile phone industry. Previous research has proposed different ways in which firms might convince customers to upgrade their products

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

(Okada, 2006). Here, we tested the idea that different aspects of design play a role in understanding consumer upgrading frequency. The findings suggest that functional design is positively associated with perceived ease of use (Chae & Kim, 2004; Hirotaka, 2003; Kurniawan et al., 2006), which, in turn, is linked to satisfaction. We expected this result since it is in line with previous research suggesting that certain aspects of design is associated with how to use a product (Bloch, 1995; Veryzer, 1995). However, unexpectedly, our data do not show significant results for the relationship between functional design and perceived usefulness. The non-significant relationship found in this study might be due to several reasons. First, as is common, we measured perceived usefulness as a list of benefits that the consumer finds with owning a product. However, since functional design in mobile phones is measured here as screen size, body width, and keyboard, it is possible that consumers mention other benefits with their mobile phone that is not directly linked to design. For instance, consumers might list benefits on a more abstract level, such as "keep in touch with other people". Second, it is also possible that consumers buy products (such as mobile phones) for hedonic reasons (Van der Heijden, 2004). Therefore, other variables, such as perceived enjoyment and pleasure, that we did not measure might be parts of the equation that would help to understand these results. Further research into this issue could prove useful in future studies.

In line with our predictions, satisfaction was associated with purchasing frequency in our data. This means that consumers who are satisfied with their mobile phone tend to be consumers who also are likely to upgrade their phones more often. More importantly for this study, the results show that elements relating to design aesthetic, such as color and body thickness, moderate the relationship between satisfaction and upgrading frequency. The findings suggest that consumers who own colorful and thin mobile phones are more likely to upgrade despite being satisfied.

Two explanations for this finding are possible. Firstly, previous research shows that the color of the product is attractive to consumers, but this attraction does not last long after purchase (Garber, Hyatt, & Starr, 2000). This may explain why consumers owning a colorful phone are more likely to upgrade at a quicker pace. Secondly, consumers of a certain type (innovators) choose to buy thin mobile phones because doing so reinforces their technology-savvy identity; as a result, these consumers are more likely to upgrade. Although these consumers may also be looking for new functional advantages, they also want to stay on top of current market trends. Since thin mobile phones are often more technologically advanced, this study's results therefore support the idea that consumers who are innovators, early adopters, or early majority upgrade more quickly (Bass, 2004). Companies frequently release trendy mobile phone designs and advertise them intensely, which may entice these types of customers to buy new mobile phones.

This study contributes to the literature on upgrading behavior by showing that design variables can help to predict upgrading behavior. Previous research has largely focused on technological advancement as a predictor for upgrading decisions (Okada 2001, 2006; Shih & Schau, 2011). In this study, we bring other variables into the equation and propose functional and aesthetic design as predictors. Our results show that a basis for frequently upgrading one's mobile phone is perceived usefulness and satisfaction, which are predicted by functional design. Also, aesthetic design seems to enhance the relationship between satisfaction and upgrading frequency, which makes aesthetic design an important component; although consumers are satisfied with their current phone, they may still upgrade for aesthetic reasons.

Implications for Practice

This study's results have implications for practitioners, too. Based on the results, practitioners should focus on different design aspects depending on whether they want to increase consumers' upgrading behavior or perceived ease of use. In order to increase perceived ease of use, firms should design phones that have a large screen, fewer visible buttons, and a relatively narrow body. However, although the data showed significant effects, the variation of width in relation to length is limited in the sample and therefore practitioners should be cautious when drawing practical implications.

Furthermore, the results indicate that, in order to increase upgrading frequency, firms should design their phones in colors other than gray, black, and white. In addition, in order to increase upgrading, firms should make their phones thinner. The results also indicate that the consumers who already own mobile phones with trendy design elements, such as vivid colors and thin body, are also those who are likely to upgrade their phone. Therefore, mobile phone firms should target customers who are in the market for phones featuring these design elements because such consumers are more likely to upgrade than customers owning models that are thicker and more traditional in color.

Limitations and future research

This study has several limitations. The first limitation concerns the results' generalizability. We tested the model in a mobile phone context and the findings cannot be directly generalized to other contexts. Further research is therefore needed to investigate if these results can be replicated (or are replicable) in other contexts. The second limitation concerns the Chinese sample since consumers from other cultures may have different attitudes toward different

types of design, and mobile phone usage might differ between cultures as Tuunanen, Peffers, Gengler, Hui, and Virtanen (2006) suggest. As such, we encourage further work on this topic in different contexts.

In addition, due to the timing of the empirical work, we were not able to fully observe the impact of touch screen interfaces and virtual keyboards on consumer's perceived ease of use and usefulness of mobile phones. From Table 3, we can see that, at the time, the majority of our subjects still had a keyboard-based mobile phone. It would be interesting to see how the transition from keyboard-based mobile phones to touch screen interfaces and virtual keyboards would change the results. Nevertheless, we see this as an interesting avenue for further research.

Furthermore, we see that the design of mobile phones offers many potential topics for future research. For example, scholars who are interested in contributing to this area may be interested in at least the following two topics. Firstly, the results suggest that consumers who own a mobile phone with aesthetic design elements are also those consumers who are most likely to frequently upgrade their mobile phones. Future research could investigate the possible relationship between the propensities of different consumer groups to adopt new products and design elements (Bass, 1969).

As technological advancements are rapid in the mobile phone industry, the product's function has changed from being an ordinary communication device to a multi-functional gadget. This change leads to what researchers call feature fatigue (Mick & Fournier, 1998; Thompson, Hamilton, & Rust, 2005) and scholars have reported that some of the consumers actually want mobile phones with fewer functionalities (Sell, de Reuver, Walden, & Carlsson, 2012). Researchers desiring to study the design elements of mobile phones could investigate how design is related to perceptions of feature fatigue.

Also, our measure of upgrading frequency is based on measures of how many mobile phones a person has previously owned. Even though the number of mobile phones a person has previously owned is likely to say something about that person and is likely to predict future behavior (Sheppard et al., 1988), it should be recognized that we cannot be sure that the upgrading rate will continue in the future. For this reason, in future research, we encourage researchers to look into this issue.

ACKNOWLEDGEMENTS

The authors would like to thank Academy of Finland for funding data collection and Dr. Oana Velcu-Laitinen for contribution in the first stages of the project.

REFERENCES

Bass, F. M. (2004). Comments on "A new product growth for model consumer durables". *Management Science*, *50*(12), 1833-1840.

Berkowitz, M. (1987). Product shape as a design innovation strategy. *Journal of Product Innovation Management, 4*(4), 274-283.

Bloch, P. H. (1995). Seeking the ideal form: Product design and consumer response. *Journal of Marketing*, *59*(3), 16-29.

Bollen, K. (1984). Multiple indicators: Internal consistency or necessary relationships? *Quality&Quantity*, *18*(4), 377-385.

Bollen, K., & Lennox, R. (1991). Conventional wisdom on measurement: A structural equation perspective. *Psychological Bulletin*, *110*(2), 205-314.

Bruner, G. C., & Kumar, A. (2005). Explaining consumer acceptance of handheld Internet devices. *Journal of Business Research*, *58*(5), 553-558.

Chae, M., & Kim, J. (2004). Do size and structure matter to mobile users? An empirical study of the effects of screen size, information structure, and task complexity on user activities with standard web phones. *Behaviour and Information Technology*, *23*(3), 165-181.

Chamblee, R., & Sandler, D. (1992). Business-to-business advertising: Which layout style works best. *Journal of Advertising Research*, *32*(6), 39-46.

Chen, J. V., Yen, D. C., & Chen, K. (2009). The acceptance and diffusion of the innovative smart phone use: A case study of a delivery service company in logistics. *Information and Management*, *46*(4), 241-248.

Chin, W.W. (1998a). Issues and opinion on structural equation modeling. *MIS Quarterly*, *22*(1), vii-xvii.

Chin, W.W. (1998b). The partial least squares approach for structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295-336). London, UK: Lawrence Erlbaum Associates.

Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small samples using partial least squares. In R. Hoyle (Eds.), *Statistical strategies for small sample research.* Beverly Hills, CA: Sage publications, 307-341.

Creusen, M. E. H., & Schoormans, J. P. L. (2005). The different roles of product appearance in consumer choice.

Journal of Product Innovation Management, *22*(1), 63–81.
Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: Consumer response to the visual domain in product design. *Design Studies, 25*(6), 547-577.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003.
Dellaert, B. G. C., & Stremersch, S. (2005). Marketing mass-customized products: Striking a balance between utility and complexity. *Journal of Marketing Research, 42*(2), 219-227.
Diamantopoulos, A., & Winklhofer, H. M. (2001). Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research*, *38*(2), 269-277.
Ermolov, V., Heino, M., Karkkainen, A., Lehtiniemi, R., Nefedov, N., Pasanen, P., Radivojevic, Z., Rouvala, M., Ryhänen, T., Seppälä, E., & Uusitalo, M. A. (2007). Significance of Nanotechnology for future wireless devices and communications. *The 18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*.
Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, *19*(4), 440-452.
Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382-388.
Garber, L., Hyatt, E. M., & Starr, R., Jr. (2000). The effects of food color on perceived flavor. *Journal of Marketing Theory and Practice*, *8*(4), 59-71.
Han S. H., Kim, K. J., Yun, M. H., Hong, S. W., & Kim, J. (2004). Identifying mobile phone design features critical to user satisfaction. *Human Factors and Ergonomics in Manufacturing*, *14*(1), 15-29.
Hertenstein, J. H., Platt, M. B., & Veryzer, R.W. (2005). The impact of industrial design effectiveness on corporate financial performance. *Journal of Product Innovation Management*, *22*(1), 3–21.
Hirotaka, N. (2003). Reassessing current cell phone designs: Using thumb input effectively. In *Proceedings of CHI '03 Extended Abstracts on Human Factors in Computing Systems* (pp. 938-939). New York: Association for Computer Machinery.
Huang, J.-H., Lin, Y.-R., & Chuang, S.-T. (2007). Elucidating user behavior of mobile learning: A perspective of the extended technology acceptance model. *The Electronic Library, 25*(5), 585-598.
Hulland, J. S. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal, 20*(2), 195-204.
Johnson, R. A., & Hignite, M. A. (2000). Applying the technology acceptance model to the WWW. *Academy of Information Management Sciences Journal, 3*(2), 130–142.
Kimle, P. A., & Fiore, A. M. (1992). Fashion advertisements: A comparison of viewers' perceptional and affective responses to illustrated and photographed stimuli. *Perceptual and Motor Skills, 75*(3), 1083-1091.
Kurniawan, S., Nugroho, Y., & Mahmud, M. (2006). A study of the use of mobile phones by older persons. In *Proceedings of CHI'06 Human Factors in Computing Systems* (pp. 989-994). New York: Association for Computer Machinery.
Lee, Y., Kozar, K. A., & Larsen, K. R. (2003). The technology acceptance model: past, present, and future. *Communications of the Association for Information Systems*, *12*(1), 752-780.
Lindholm, C., Keinonen, T., & Kiljander, H. (2003). *Mobile usability—how Nokia changed the face of the mobile phone*. New York: McGraw-Hill.
Meyer, R. J., Zhao, S., & Han, J. K. (2008). Biases in valuation vs. usage of innovative product features. *Marketing Science*, *27*(6), 1083-1096.
Mick, D. G., & Fournier, S. (1998). Paradoxes of technology: Consumer cognizance, emotions and coping strategies. *The Journal of Consumer Research*, *25*(2), 123-143.
Moreau, C. P., Markman, A. B., & Lehmann, A. B. (2001). "What is It?" Categorization flexibility and consumers' responses to really new products. *The Journal of Consumer Research*, *27*(4), 489-498.
Mugge, R., Govers, P. C. M., & Schoormans, J. P. L. (2009). The development and testing of a product personality scale. *Design Studies*, *30*(3), 287-302.
Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.
Okada, E. M. (2001). Trade-ins, mental accounting, and product replacement decisions. *Journal of Consumer Research*, *27*(4), 433-446.
Okada, E. M. (2006). Upgrades and new purchases. *Journal of Marketing*, *70*(4), 92-102.
Person, O., Snelders, D., Karjalainen, T.-M., & Schoormans, J. (2007). Complementing intuition: Insights on styling as a strategic tool. *Journal of Marketing Management*, *23*(9-10), 901-916.
Petter, S., Straub, D., & Rai, A. (2007). Specifying formative constructs in information systems research. *MIS Quarterly*, *31*(4), 623-656.
Roehm, M. L., & Sternthal, B. (2001). The moderating effect of knowledge and resources on the persuasive impact of analogies. *Journal of Consumer Research*, *28*(2), 257-272.

Sell, A., de Reuver, M., Walden, P., & Carlsson, C. (2012). Context, gender and intended use of mobile messaging, entertainment and social media services. *International Journal of Systems and Service-Oriented Engineering*, *3*(1), 1-15.

Sewall, M. A. (1978). Market segmentation based on consumer ratings of proposed product designs. *Journal of Marketing Research*, *15*(4), 557-564.

Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, *15*(3), 325–343.

Shih, E., & Schau, H. J. (2011). To justify or not to justify: The role of anticipated regret on consumers' decisions to upgrade technological innovations. *Journal of Retailing*, *87*(2), 242-251.

Talke, K., Salomo, S., Wieringa, J. E., & Lutz, A. (2009). What about design newness? Investigating the relevance of a neglected dimension of product innovativeness. *Journal of Product Innovation Management*, *26*(6), 601–615.

Thompson, D. V., Hamilton, H. W., & Rust, R. T. (2005). Feature fatigue: When product capabilities become too much of a good thing. *Journal of Marketing Research*, *42*(4), 431-442.

Tractinsky, N., Katz, A. S., & Ikar, D. (2000). What is beautiful is useable. *Interacting with Computers*, *13*(2), 27-145.

Tuunainen, V., & Tuunanen, T. (2011). IISIn—a model for analyzing ICT intensive service innovations in n-sided markets. *Proceedings of the 44th Hawaii International Conference on System Sciences*.

Tuunainen, V., Tuunanen, T., & Bastek, M. (2009). A model for ICT intensive service innovations in two-sided markets—case study of IPTV in a national TV broadcasting company. *Proceedings of the 2009 International Conference on New Trends in Information and Service Science.*

Tuunainen, V., Tuunanen, T., & Piispanen, J. (2011). Mobile service platforms: Comparing Nokia OVI and Apple App Store with the IISIn model. *Proceedings of the Tenth International Conference on Mobile Business,* 74-83.

Tuunanen, T., Peffers, K., Gengler, C., Hui, W., & Virtanen, V. (2006). "Developing feature sets for geographically diverse external end users: A call for value-based preference modelling. *Journal of Information Technology Theory and Application*, *8*(2), 41-55.

Vadas, K., Patel, N., Lyons, K., Starner, T., & Jacko, J. (2006). Reading on-the-go: A comparison of audio and hand-held displays. In *Proceedings of the 8th Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 219-226). New York: Association for Computer Machinery.

Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS Quarterly*, *28*(4), 695-704.

Veryzer, R. W., Jr. (1995). The place of product design and aesthetics in consumer research. In K. R. Kardes & M. Sujan (Eds.), *Advances in consumer research* (pp. 641-645). Provo, UT: Association for Consumer Research.

Veryzer, R. W. (2000). Design and consumer research. *Design Management Journal Academic Review, 1*(1), 64–73.

Warlop, L, Ratneshwar, S., & van Osselaer, S. M. J. (2005). Distinctive brand cues and memory for product consumption experiences. *International Journal of Research in Marketing*, *22*(1), 27-44.

Wu, J.-H., & Wang, S.-C. (2005). What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. *Information & Management*, *42*(5), 719-729.

Yalch, R., & Brunel, F. (1996). Need hierarchies in consumer judgements of product designs: Is it time to reconsider Maslow's theory? In K. P. Corfman & J. G. Lynch, Jr. (Eds.), *Advances in consumer research* (pp. 405-410.). Provo, UT: Association for Consumer Research.

Yun, M. H., Han, S. H., Hong, S. W., & Kim, J. (2003). Incorporating user satisfaction into the look-and-feel of mobile phone design. *Ergonomics*, *46*(13-14), 1423-1440.

ABOUT THE AUTHORS

Maria Sääksjärvi is an Associate Professor of Marketing at Delft University of Technology, the Netherlands. Her research focuses on innovations, emotions, and branding, with an emphasis on what makes new products succeed in the market. She also works in the areas of measurement and statistics. Prior to her academic career, she worked at Accenture as a consultant. She has published in *Journal of Academy of Marketing Science*, *Journal of Interactive Marketing*, *Journal of Marketing Management*, *Journal of Personal Selling and Sales Management*, *PLOS One*, *Psychology & Marketing*, among others.

Katarina Hellén works as an Assistant Professor at University of Vaasa in Finland. Her research interest centers around consumer well-being, personality and interpersonal comparisons. She has published in *Psychology & Marketing, Journal of Service Management,* and *Journal of Marketing Management* among others.

Tuure Tuunanen is a Professor in the Department of Computer Science and Information Systems at the University of Jyväskylä in Finland. He has previously held positions in, e.g., Aalto University School of Business and University of Auckland Business School. He is also a global faculty fellow of the Center for Service Leadership at Arizona State University. He holds a D.Sc. (Econ.) from the Aalto University School of Business. His research has been in the cross-sections of information systems, software engineering, and service research and he is currently interested in multi-disciplinary research in the area of ICT enabled service design and innovations. Dr. Tuunanen's research has been published in premier research outlets in his field, such as, at *Journal of Management Information Systems*, *Journal of Association for Information Systems*, and *Journal of Service Research*. He is currently an Associate Editor of Journal of Service Research. He is also the president of IRIS, The Scandinavian Chapter of The Association for Information Systems.

JITTA

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

JITTA is a Publication of the Association for Information Systems
ISSN: 1532-3416