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DO YOU GET BETTER USER EXPERIENCES WHEN YOU CUSTOMIZE YOUR SMARTPHONE?: AN EXPERIMENT WITH OBJECT AND BEHAVIOR-BASED BELIEFS AND ATTITUDES

Ying Wang
Capital Normal University, psymaster@126.com

Chee-Wee Tan
Copenhagen Business School, cta.itm@cbs.dk

torkil clemmensen
Copenhagen business school, tc.itm@cbs.dk

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Wang, Ying, Capital Normal University, West Third Ring Road North, Haidian District, Beijing, China, psymaster@126.com

Tan, Chee Wee, Copenhagen Business School, Solbjerg Plads 3, DK-2000 Frederiksberg, Denmark, cta.itm@cbs.dk

Clemmensen, Torkil, Copenhagen Business School, Solbjerg Plads 3, DK-2000 Frederiksberg, Denmark, tc.itm@cbs.dk

Abstract

A system can be customized by is owner. The fundamental premise behind designing for customization is that it improves the user experience (UX) of the system. In this study, we contend that the effects of customization on UX of a smartphone can be theoretically modelled as users' beliefs about the system object (customization) that influence their attitudes towards the system object (perceived system usability), which in turn shapes their beliefs (flow) and attitudes (engagement) towards using the system. We tested this proposition via an experimental study with 50 college students as participants. Each participant was asked to perform customization tasks on a smartphone, and then instructed to complete a comparison task aimed at contrasting customized user interface with a standard one. Our manipulation checks confirmed that the customization task, in particular, the customization of the layout was more pronounced for participants. Analytical results from the comparison reveal that customization positively influence users' evaluation of three key constructs of UX: perceived system usability, flow and engagement, and that the feeling of engagement is mediated through perceived system usability and flow. We conclude with a discussion of the impact of customization on UX, and whether the distinction between object- and behaviour-based beliefs and attitudes is helpful.

Keywords: User Experience, Perceived System Usability; Flow; Engagement; Layout Customization; Functional Customization, Smartphone.

1 Introduction

A core idea behind designing for customization is that it can improve the usability and user experience (UX) of the IT artifact, service, or system (Böhmer & Krüger, 2013; Olwal, Lachanas, & Zacharouli, 2011; Zeidler, Lutteroth, & Weber, 2013). The notion of designing for customization of software and hardware products by end-users themselves is an enduring idea that has been presented as a means of: (1) allowing these end-users to boost their productivity (Page, Johnsgard, Albert, & Allen, 1996), and; (2) helping companies to better meet customers' needs (Piller, Schubert, Koch, & Moesleim, 2004). UX is a more recent idea with little consensus within extant literature on how to operationalize UX as well as its distinguishability from usability in general. Whereas usability and UX are often defined as qualities of the customizable system itself, there are instances when usability and UX are conceptualized in terms of system usage, thereby implying an indirect link to customization. It is hence difficult to accurately assess the connection between system customization and UX. In this paper, we submit that the relationship between customization and UX of a system can be theorized and modelled as beliefs about the system as an object (customization) that influence users' corresponding attitudes towards the system object (perceived system usability), which in turn shapes their behavioural beliefs (flow) and attitudes (engagement) about utilizing the system. Arguably, if a user can customize a system to match the task at hand, the gap between his/her beliefs and attitudes about the system itself, and his/her beliefs and attitudes towards the utilization of the system would be reduced. In this study, we set out to scrutinize the impact of system customization on UX in the context of smartphones.

A smartphone can be customized by is owner. Customization is crucial for smartphone usage because users tend to multi-task on their own mobile phones so much so that these phones become a platform for value reconfiguration. That is, users are constantly configuring the composition and layout of apps on their smartphones in response to their most immediate needs. It is thus not surprising that smartphones are typically conceived as objects highly valued by their users, both in terms of beliefs about what they can do (e.g., it is really smart and customizable), and also with regards to their attitudes towards them (e.g., I love my iPhone, it is part of me and very easy to learn and to use). People may frequently touch and care and admire their iPhone as a precious object. This is, however, distinct from their beliefs about how the smartphone is in use in a given organization and/or work environment. Consequently, it is imperative to also unravel the factors driving users' beliefs about their ability to utilize their smartphones seamlessly for their work. If we can establish the impact of system customization on UX, we would have embarked on a concrete step towards comprehending the relationship between customization and UX in diverse work contexts. Moreover, while UX has been examined substantially in the field of Human-Computer Interaction (HCI), prior research rarely touches on parameterization, leading to a knowledge gap in the contextualized investigation of designing for customization (e.g., in smartphone designs). We hence endeavoured to answer the following research question in this paper: *Do you get better user experience when you customize your smartphone?*

The remaining sections of the paper are structured as follows. We first describe our theoretical model that is grounded in Wixon and Todd's (2005) differentiation between object- and behaviour-based beliefs and attitudes. Additionally, we elaborate on the relationships between between customization and three key UX constructs: perceived system usability, flow and engagement. Next, in the method section, we outline the procedures for our experimental study as well as for our data collection and analysis efforts. The results section presents the outcome from our manipulation of the customizability of a smartphone as well as the findings from the analysis of our Structural Equation Model (SEM). In the discussion section, we discuss the implications for theory and practice to be gleaned from this study.

2 Theoretical framework

Our theoretical model is illustrated in Figure 1 below. Building on the work of Wixom and Todd (2005), we draw a distinction between object- and behaviour-based beliefs and attitudes (Wixom &

Todd, 2005). Whereas object-based beliefs capture what a user thinks a system is equipped to do, object-based attitudes reflect the user's general feeling about what the system is capable of. Conversely, behaviour-based beliefs capture what the user thinks he or she can accomplish with the system whereas behaviour-based attitudes reflect the user's general feeling of what is achievable through system utilization. Wixom and Todd (2005) alleged that users' object-based beliefs and attitudes act as external drivers (or design attributes) that shape their corresponding behaviour-based beliefs and attitudes, thereby culminating in observable behaviour on the part of these users.

One primary reason why we turn to Wixom and Todd (2005) as our conceptual lens for bridging the knowledge gap between customization and UX is because it sheds light on the cognitive-behavioural process underlying users' evaluation of customizable systems, which in turn permits both scholars and practitioners to gain an in-depth appreciation of the impact of customization on system usage. This has been shown to be highly valuable not only in information system studies, but also for furthering HCI research (Hekler, Klasnja, Froehlich, & Buman, 2013). Furthermore, our theoretical model contributes to recent attempts in integrating utilitarian-based technology acceptance models with more affective interaction experience and hedonic UX (Van Schaik & Ling, 2011).

In sections 2.1 – 2.4 below, we explain the focal constructs depicted in our theoretical model.

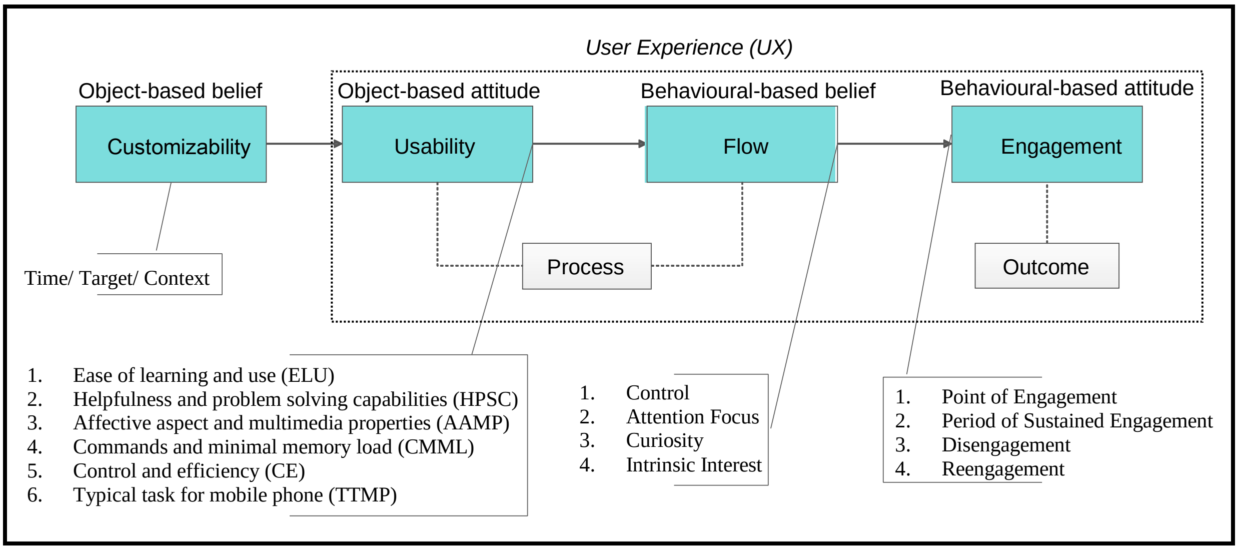

Figure 1. Theoretical Model of Customization for User Experience

2.1 Customization

In our theoretical model, we conceive object-based beliefs in terms of the customizability of a system. It is natural for distinct users to display an affinity for different system requirements depending on a multiplicity of contextual conditions, which include their role, preferred workflow, expertise, visual acuity, motor skills and the devices they own. For this reason, they often customize systems to meet their varying needs. We approach the notion of customization in systems by focusing on two key aspects. The first is presentation or layout customization, which allows users to perform complex layout editing by adding, removing and/or rearranging select widgets constituting a system. The other is task-oriented or functional customization, which enables users to modify the behaviour of a system, by adding, removing and/or rewiring functional components of the system (Marathe, 2009; Zeidler, et al., 2013). This distinction is supported by past studies that examine how people customize their smartphone. For example, (Böhmer & Krüger, 2013) found that most smartphone users not only arrange or cluster app icons in order to quickly access frequently used apps and easily switch among alternatives, but they also customize the layout of their smartphone in order to have a nice looking start screen. While we do acknowledge that there are other aspects of customization not explored in this paper, we have decided to focus on the customizability of the interface because we believe that the interface is the *focal* point of contact between a system and its users. This stands in contrast to other forms of customization such as: (1) customization of business processes underlying systems, and; (2) customization of external appearances (e.g., engraving one's name on the back of a phone). Coming from a psychological standpoint, (Marathe & Sundar, 2011) found that user customization can be attributed to an innate desire for a sense of identity as well as a sense of control. Ideally, if the user–after having performed layout and functional customization of a system–is convinced that the system and its output match the time, target and context of the work to be accomplished via the system (an object based belief), he/she will feel fully engaged when interacting with the system. However, we argued that the impact of customization on engagement is mediated through users' evaluations of perceived system usability and flow.

2.2 Perceived System Usability

Usability is not well defined within extant literature (Hornbæk & Law, 2007) with numerous operationalization of the construct being put forward in past studies (Hornbæk, 2006). In our theoretical model (see Figure 1), we interpret object-based attitudes as users' evaluation of perceived system usability because it mirrors users' attitude towards the overall usability of a system as an object. Notably, a well-established system usability instrument is the System Usability Scale (SUS). This scale is a ten-item scale giving a global assessment of Usability, operationally defined as the subjective perception of users' interaction with a system (Brooke, 1996). The SUS items have been developed according to the three usability criteria stipulated in the ISO 9241-11: (1) users' ability to accomplish tasks using the system and the quality of outputs from task accomplishment (i.e., effectiveness); (2) level of resources consumed in task performance (i.e., efficiency), as well as; (3) users' subjective reactions from using the system (i.e., satisfaction). Recently, Lewis and Sauro (2009) advanced a two-factor structure—usability and learnability—suggesting that practitioners might take advantage of these novel factors to extract additional information from SUS data. Consistent with (Ryu & Smith-Jackson, 2006) work, we construe perceived system usability as a multi-dimensional construct. Through an incremental development and validation process, (Ryu & Smith-Jackson, 2006) characterized system usability as comprising six main qualities: (1) ease of learning and use; (2) helpfulness and problem solving capabilities; (3) affective aspect and multimedia properties; (4) commands and minimal memory load; (5) control and efficiency, as well as; (6) typical task for mobile phone. Building on (Ryu & Smith-Jackson, 2006) multi-dimensional characterization of system usability, we assert that a user, who had customized a system to fit their needs (i.e., time, target and context), is more likely to develop positive attitudes towards the system itself (i.e., object based attitude). This in turn culminates in perceptions of better usability of this system. This idea resonates with Wixon and Todd's (2005) arguments that one's beliefs about objects are linked to their attitudes towards those objects. Also, an empirical study of how people customize their smartphones showed that a majority of users customized their smartphone for usability reasons (Böhmer & Krüger, 2013). We thus hypothesize that customization, as operationalized in terms of (Ryu & Smith-Jackson, 2006) six dimensions of quality, should bolster users' perceptions of system usability:

H1: Customization increases perceived system usability.

2.3 Flow

In our theoretical model (see Figure 1), we interpret behaviour-based beliefs as flow experiences. Flow represents a subjective psychological temporary experience (state) that characterizes the human-computer experience as playful and exploratory (Webster, Trevino, & Ryan, 1994). According to (Csikszentmihalyi, 1975), flow is a multidimensional construct characterized by four dimensions, namely control, attention focus, curiosity and intrinsic interest. (Webster, et al., 1994) however uncovered only three dimension in their empirical study (control and attention focus were found, but curiosity and intrinsic interest could be merged into 'cognitive enjoyment'). Webster et al (1994) further suggested that users' belief about their ability to explore and experiment with systems as well as customize these systems to meet their needs (i.e., perceptions of a system as being flexible and modifiable) will correlate with their experience of flow. This in turn, implies a link between users' belief and attitudes towards a system itself, and their flow experience. Likewise, Finneran & Zhang (2002) have maintained that perceived ease of use with regards to a system will influence the sense of control and challenge, which should be seen as contributing to users' flow experience.

Wixon and Todd (2005) suggested that object-based attitudes (e.g., information and system satisfaction) are salient predictors of users' behaviour-based beliefs (e.g., extent to which a system will be useful for the user in his/her workplace). Adhering to this line of reasoning, we posit that users' positive attitudes towards a system after customization will positively influence their beliefs of positive experiences to be gained from interacting with the system. In other words, we hypothesize that users' perceptions of system usability, as measured via the six qualities advocated by (Ryu & Smith-Jackson, 2006), should correlate with enhanced flow experiences with respect to control, attention focus, curiosity and intrinsic interest as proposed by (Webster, et al., 1994):

H2: Perceived system usability positively influences flow experiences.

2.4 Engagement

The definition of the user engagement is fragmented within extant literature. Attfield, Kazai, Lalmas, and Piwowarski (2011) concluded that engagement is the emotional, cognitive and behavioural connection that exists, at any point in time and possibly over time, between a user and a resource. Engagement is not just about how a single interaction unfolds, but it is also about how and why people develop a relationship with technology and integrate it into their lives. (Quesenbery, 2003), as cited in (O'Brien & Toms, 2008), argued for engagement as a sub-dimension of usability in the sense that engagement is influenced by users' first impression of a system and the enjoyment they derive from utilizing it (what we would term as object-based belief and attitudes as well as behaviour-based beliefs and attitudes respectively). (O'Brien & Toms, 2008) thus conceptualized engagement as a process consisting of four distinct stages: point of engagement, period of sustained engagement, disengagement, and reengagement. The point of engagement is when the user feels that the aesthetics or informational composition of the system interface resonates with the user to capture his/her attention and interest, thereby moving her forward into engagement. The period of sustained engagement is marked by the attention users are able to pay to their task and the application, the novelty of their experience, their level of interest, and their evaluations of challenge, feedback and feelings of control during interaction. Disengagement happens when users lose interest, are distracted or interrupted, or when there is a lack of novelty in the application, or usability issues with the technology. The re-engagement can be due to involuntary disengagement caused by system disruptions, task switching or unfulfilled positive experiences with the application in comparison to the past, such as feeling of fun, learning, and novelty. For this study, we concentrate specifically on period of sustained engagement, which refers to the duration in which users are immersed in system interactions (or what is known as felt engagement).

Following Wixom and Todd (2005), who claimed that intention to use is driven by behavioural attitudes towards use and usefulness, we postulate that engagement can be viewed as a behaviour-based attitude, which is shaped by corresponding behaviour-based beliefs about the system in use (i.e., flow experiences). We thus hypothesize that:

H3: Flow experiences positively influences engagement

O'Brien & Toms (2010), in their follow-up work, put forth a multidimensional scale for measuring engagement, from which we have adapted items to measure engagement in this study.

In summary, a large body of research over the past decade, e.g., (Attfield, et al., 2011; Chapman, Selvarajah, & Webster, 1999; O'Brien & Toms, 2008, 2010; Webster, et al., 1994), has demonstrated consistently that perceived usability and flow play an instrumental role in improving users' engagement and overall experience with systems. If a smartphone can be customized to support high perceived system usability and deliver a good flow experience, it should result in enhanced engagement as depicted in Figure 1. Our theoretical model may also be relevant to website design. In a majority of contemporary websites, users can customize the site according to their requirements, which may lead to better perceptions of system usability and flow experiences, which in turn improve engagement.

In the next section, we outlined an experimental study in which we validate users' task performance when presented with a standardized versus a customized system interface. Data was gathered via a combination of survey questionnaires and video recordings of experimental sessions for each participant in order to elicit objective information about how they interact with the two interfaces as well as their subjective evaluations about both interfaces.

3 Method

3.1 Pilot Study

The system employed for this experimental study are smartphones due to the latter's popularity and growing predominance in our daily lives. Before the actual experiment, we conducted semi-structured interviews with seven participants (two females, five males; ages between 28 and 55). First, we presented the participants with an experimental task that they were expected to accomplish by utilizing a Nokia Lumia 900 smartphone supplied by the researchers. Next, they were asked to answer a preliminary draft of a survey questionnaire containing a series of statements regarding the usability of the smartphone in assisting them to accomplish the aforementioned task. For each statement, they were instructed to indicate the level of agreement or disagreement with the statements. They were then interviewed about their most recent user experience with the smartphone. The purpose of the pilot study was to confirm whether the questionnaire was adequate for measuring the constructs of interest depicted in our theoretical model (see Figure 1). The pilot study resulted in a refined version of the questionnaire with a total of 52 measurement items. Through the pilot study, novel measures were developed based on interviews with users. In addition, we deleted five ambiguously phrased items from the initial version of the questionnaire. Each measurement item was scored using the same 7-point Likert scale. Findings from the pilot study were invaluable in assisting us to develop appropriate questions for customization, perceived system usability, flow, and engagement as described above. Eventually, we ended up with two survey questionnaires to be administered in the actual experiment: one for 'Customization' and one for 'Comparison'.

3.2 Main Study

The main purpose of the study was to comprehend distinctions between 'customization' and 'standardization' conditions when utilizing the Nokia Lumia 900 smartphone and how these conditions shape users' evaluations of perceived system usability, flow and engagement. The research design was a within-subject experiment, including two trials, as every participant was assigned to 'customization' and 'standardization' conditions respectively. The order of the assignment was balanced.

3.2.1 Participants

Fifty participants (25 males and 25 females, with normal visual acuity) were recruited from Capital Normal University in China. Their ages ranged from 23 to 32 (M = 26.22, SD = 2.141). Of the 50 participants, 47 had more than five years of mobile phone experience and three possessed between 2 to 5 years of experience. Participants reported that they tend to utilize their mobile phones all day long to perform call, chat and messages. Of the 50 participants, 10 utilized iPhones, 35 utilized Android, four utilized Windows Phone, and one utilized an alternate brand. 23 participants preferred the standardized system interface, and 27 the customized one. 47 participants had never participated in experimental studies involving user testing before while three participants had prior experience in such studies. Three participants had a Bachelor degree, 46 had a Master degree, and one a Doctoral degree. Participants were reimbursed with monetary incentives for their effort in participating in our study.

3.2.2 Type of Smartphone in Experimental Study

Smartphones used in this experimental study were the Nokia Lumia 900 smartphone, installed with Windows Phone 7 software and Chinese language settings as illustrated in Figure 2. In light of the purpose of our experimental study, we used a total of three separate smartphones: one had a standard setup and was used to train the participant in thinking aloud and becoming familiar with the smartphone and the apps on it. The two other phones also had a standard interface, but one was used to allow participants to perform ‘customization’ and the other to accord participants with the experience of a ‘standard’ smartphone.

3.2.3 Development of Measurement Items

The survey questionnaire[1] administered in this study comprises 47 questions that requested participants to rate, on a seven point semantic differential scale ranging from ‘‘A is much better than B ’to ‘B is much better than A ’, the extent to which the standardized user interface is preferred over its customized counterpart for certain tasks. A major part of the questionnaire centred on perceived system usability with 31 questions touching on aspects of *learning ability*, *problem solving capabilities*, *multimedia properties*, *memory load*, *control efficiency* and *typical task*. The remaining parts consisted of six questions about flow and nine questions about engagement.

Figure 2. Nokia Lumia 900 smartphone w/ customized interface

3.2.4 Procedure

The experiment was conducted in the laboratory of the Capital Normal University in China. Each participant was led individually into the laboratory. After a brief introduction by the experimenter (the first author), the participant was told to sign a consent form and provide relevant background information: gender, age, amount of time spent on mobile phones and other plausible confounding variables including education and habits of smartphone usage. Before performing the experimental tasks, participants were trained to think aloud and to familiarize themselves with the Nokia Lumia 900 smartphone including how to customize it. Thinking aloud was necessary because the experimental session for each participant was video recorded. Next, each participant was asked to perform two tasks: the comparison task and the customization task. In the comparison task, participants were presented with a Nokia Lumia 900 smartphone with the default, standard interface, and instructed not to alter any settings. Participants were then requested to perform the two most frequent tasks which they would normally perform on their mobile phones on a daily basis (participants had already provided details about frequent tasks they perform on smartphones at the beginning of the experiment). In the customization task, we presented the participant with an identical Nokia Lumia 900 smartphone, but with no predetermined tiles

[1] Due to page constraints, we are able to include a list of the measurement items incorporated into our survey questionnaire, but it can be made available upon written request to the authors.

on the start page. Participants were then asked to add tiles (functional customization) and arrange the layout (layout customization) as they wished (they had received training on how to customize the smartphone at the beginning of the experiment). The order in which the comparison and the customization tasks were given to the participant was balanced across participants.

After the participants had performed the customization and comparison tasks, they were presented with the survey questionnaire containing items about perceived system usability, flow and engagement. The experimenter then interviewed the participants to clarify any issues that may had emerged during the performance of the experimental tasks and/or the completion questionnaires. All questionnaires were presented in paper-pencil format. Each session was recorded. The whole experiment lasted for approximately one hour per participant.

4 Results

4.1 Measurement Model

All constructs were modeled reflectively and the results of the comparison task for each construct in our theoretical framework are shown in Table 1.

		M	SD
Usability	Ease of Learning and Use	4.85	1.40
	Helpfulness and Problem Solving Capabilities	4.79	1.26
	Affective Aspect and Multimedia Properties	4.49	0.94
	Commands and Minimal Memory Load	4.82	1.28
	Control and Efficiency	4.61	1.24
	Typical Task for Mobile Phone	4.65	1.16
Flow		5.21	1.16
Engagement		4.16	1.20

Table 1. Results of Comparison Task

The test of our measurement model involves the estimation of internal consistency as well as the convergent and discriminant validity of the measurement items included in our survey instrument. We assessed the measurement properties of the reflective items in the model using Cronbach's alpha (Nunnally & Bernstein, 1994), composite reliability, and the Average Variance Extracted (AVE) (Fornell & Larcker, 1981). As illustrated in Table 2, the majority of constructs far exceed recommended thresholds, thus supporting convergent validity. For discriminant validity to hold, the square root of AVE for each construct should be greater than its correlations with any other construct. This indicates that the construct shares more variance with its own measures than it shares with other construct (Fornell & Larcker, 1981). As can be seen from the inter-construct correlation matrix in Table 2, the majority of constructs also display sufficient discriminant validity.

Construct	AVE	Composite Reliability	Cronbach's α	AAMP	CMML	CNE	ELU	ENG	FLO	HPSC	TTMP
Affective Aspects and Multimedia Properties (AAMP)	**0.525**	**0.813**	**0.700**	**0.724**							
Commands and Minimal Memory Load (CMML)	**0.560**	**0.791**	**0.609**	0.665	**0.749**						

Control and Efficiency (CNE)	**0.676**	**0.861**	**0.759**	0.612	0.562	**0.822**					
Ease of Learning & Use (ELU)	**0.399**	**0.884**	**0.854**	0.550	0.662	0.669	**0.632**				
Engagement (ENG)	**0.322**	**0.805**	**0.734**	0.450	0.485	0.519	0.440	**0.568**			
Flow (FLO)	**0.564**	**0.886**	**0.843**	0.257	0.412	0.453	0.412	0.714	**0.751**		
Helpfulness and Problem Solving Capabilities (HPSC)	**0.669**	**0.858**	**0.751**	0.620	0.487	0.700	0.652	0.400	0.332	**0.818**	
Typical Task for Mobile Phone (TTMP)	**0.510**	**0.804**	**0.672**	0.620	0.663	0.639	0.631	0.539	0.409	0.469	**0.714**

Table 2. Inter-Construct Correlation Matrix

4.2 Hypotheses Testing

To investigate the impact of customization on perceived system usability, we conducted a one-sample *t*-test[2] against the neutral pivot value of *4.0* in our measurement scale (see Table 3): we tested the null hypothesis that participants are indifferent between standardized and customized smartphone interface when evaluating perceived system usability. As illustrated in Table 3, participants preferred the customized smartphone interface over that of the standardized one when evaluating its usability along each of the latter's six constituent sub-dimensions: *affective aspects and multimedia properties* [$t_{(49)}$ = 4.944; p = .000], *commands and minimal memory load* [$t_{(49)}$ = 6.252; p = .000], *control and efficiency* [$t_{(49)}$ = 5.149; p = .000], *ease of learning and use* [$t_{(49)}$ = 6.974; p = .000], *helpfulness and problem solving capabilities* [$t_{(49)}$ = 5.336; p = .000] as well as *typical task for mobile phone* [$t_{(275)}$ = 5.055; p = .000]. This in turn suggests that participants' prefer the customized smartphone interface over its standardized counterpart in terms of system usability, thereby confirming Hypothesis 1.

Construct	**Test Value = 4.00**					
	t	***df***	**Sig. (2-tailed)**	**Mean Difference†**	**95% Confidence Interval**	
					Lower	**Upper**
Affective Aspects and Multimedia Properties (AAMP)	4.944	49	.000	.593556960	.35230807	.83480585
Commands and Minimal Memory Load (CMML)	6.252	49	.000	.846400180	.57433328	1.11846708
Control and Efficiency (CNE)	5.146	49	.000	.616865580	.37595295	.85777821
Ease of Learning and Use (ELU)	6.974	49	.000	.890958240	.63423071	1.14768577
Engagement (ENG)	6.734	49	.000	.702251040	.49267668	.91182540
Flow (FLO)	9.768	49	.000	1.214139760	.96434973	1.46392979
Helpfulness and Problem Solving Capabilities (HPSC)	5.336	49	.000	.771987040	.48125280	1.06272128
Typical Task for Mobile Phone (TTMP)	5.055	49	.000	.589949460	.35540633	.82449259

† Positive difference implies customized interface is preferred over standardized interface

Table 3. Analytical Results from One-Sample t-Test

[2] The one-sample *t*-test is applicable whenever we collect data on a single sample drawn from a defined population in order to compare our sample statistic (M) to a known population parameter (μ). The population parameter tells us what to expect if our sample came from that population, which in our case refers to the group of individuals who are indifferent between customized and standardized smartphone interface. If the *t*-statistic is very different (beyond what we would expect from sampling error), then we can conclude that our sample came from a different population. Furthermore, there is no specification of a minimum sample size for the one-sample *t*-test to be valid, just that the sample must be normally distributed.

To test Hypotheses 2 and 3, we analyzed the structural properties of our theoretical framework by modeling system usability as a second-order aggregate construct consisting of its six constituent sub-dimensions (i.e., affective aspects and multimedia properties, commands and minimal memory load, control and efficiency, ease of learning and use, helpfulness and problem solving capabilities as well as typical task for mobile phone). Results from the analysis of the structural model via SmartPLS 2.0.M3, including path coefficients and their statistical significance, are illustrated in Figure 3.

As anticipated, the multi-dimensional properties of system usability are upheld by the empirical evidence. Each of the six constituent sub-dimensions is a highly significant contributor to system usability: *affective aspects and multimedia properties* ($\beta = 0.136$, $p < 0.001$), *commands and minimal memory load* ($\beta = 0.131$, $p < 0.001$), *control and efficiency* ($\beta = 0.175$, $p < 0.001$), *ease of learning and use* ($\beta = 0.428$, $p < 0.001$), *helpfulness and problem solving capabilities* ($\beta = 0.157$, $p < 0.001$) as well as *typical task for mobile phone* ($\beta = 0.166$, $p < 0.001$). In turn, system usability exerts a positive and significant effect on *flow* ($\beta = 0.479$, $p < 0.001$), explaining 22.9% of the variance in the latter. Hypothesis 2 is hence corroborated. Flow reveals a significantly positive impact on engagement ($\beta = 0.714$, $p < 0.001$), explaining 51% of the variance in the latter and substantiating Hypothesis 3.

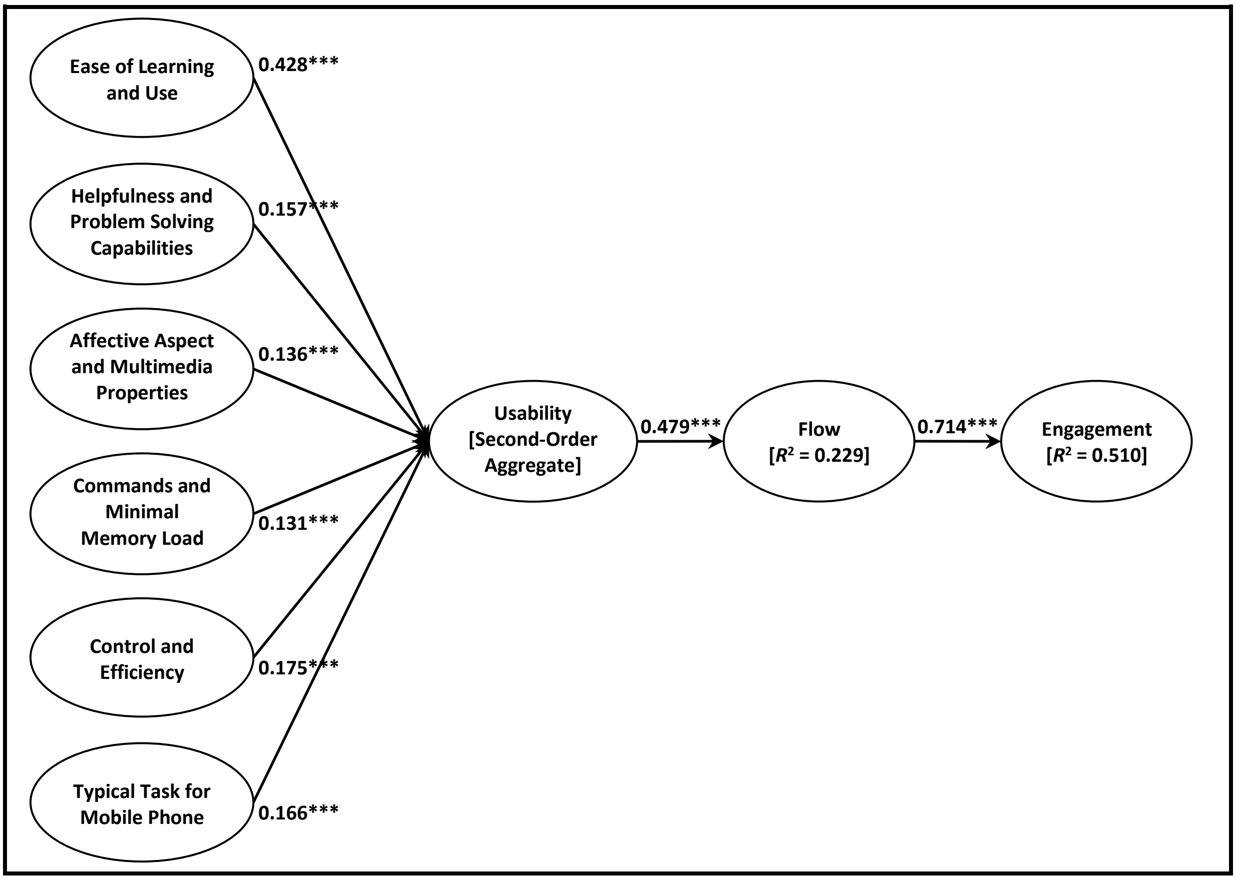

Figure 3. Structural Equation Model (SEM) Analysis

5 Discussion

5.1 Do you get better UX when you customize your smartphone?

In this study, we endeavoured to answer the research question of whether *users gain better user experience from customizing their smartphones*. To answer this question, we draw on the work of Wixom and Todd (2005) to construct and validate a theoretical model together with three testable hypotheses, which allude to a positive impact of customization on UX. Specifically, through our experimental study, we could illustrate that proactive customization of a smartphone by a user translates into an increase in his/her feeling of engagement with the smartphone and that that this relationship was mediated via perceived system usability and flow. From the findings, we can deduce that users do benefit from better user experience through system customization because customized interfaces improve users' perceptions of system usability and flow experiences, culminating in greater engagement.

5.2 Is the distinction between object and behaviour based beliefs and attitudes helpful?

This study provides validity to our decision to apply Wixom and Todd (2005)'s distinction between object and behaviour-based beliefs and attitudes in modelling the effects of system customization on UX. We could model theoretically, in explicit detail and an operationalizable fashion, the relationship between customization and UX of a smartphone. In other words, the impact of system customization on UX can be viewed as a process beginning with users' beliefs about the system object (customization) to their attitudes towards the system (perceived system usability) and then concluding with their beliefs (flow) and attitudes (engagement) towards using the system object.

This kind of cognitive-behavioural models may be valuable for connecting customization to UX because it allows both researchers and practitioners to explain and predict the impact. (Hekler, et al., 2013) have suggested that behaviour theory is useful for current attempts to appropriate technology for facilitating behavioural change in domains such as health and sustainability. Our model reveals that customization of persuasive technologies (e.g., power consumption saving devices) may increase users' engagement in the utilization of such technologies. The model also identifies perceived system usability and flow as something that the design of technology can improve by supporting system customization. Speculatively, the infamous attitude-behaviour gap in green technology design (i.e., users' tendency to shy away from green technology despite claiming to the contrary), may be better understood by applying this object-behaviour distinction. The model may be usable well beyond the traditional behaviour change domains in the likes of e-commerce or digital government.

The object-behaviour distinction may help in offering conceptual clarity to characterizations of usability and UX, which remain elusive within extant literature (Hornbæk, 2006). The model may help to point out that diverse interpretations of usability and UX could be narrowed down to discrepancies regarding whether usability and UX are treated as external object-based beliefs and attitudes about what a system is equipped to do (which may or may not be important in life and work domains) or as behavioural beliefs and attitudes about what the user can gain from interacting with the system.

Alternative attempts to integrate utilitarian technology acceptance models with interaction experience and hedonic UX (e.g., (Van Schaik & Ling, 2011), have the additional benefit of cleaning up terminology in the area. We believe, however, that the statistically significant relationships among the constructs in our theoretical model provides empirical evidence that allows us to reach back one step back in the design process, and give designers new reasons to design for customizability.

5.3 Can users customize for UX?

Customization of end-user software and hardware products has often been treated as mass-customization on the part companies, to the extent to which researchers have felt compelled to argue that users themselves *can* actually co-design and customize the product that they use (Piller, et al., 2004). Similarly, understanding UX has evolved into a complex issue in academic research; for example understanding and evaluating user engagement in e-commerce environments is by now conceptualised as a highly intertwined and complex user-system interplay (O'Brien & Toms, 2010). In contrast, our model is much more straightforward in suggesting links between customization and UX. This fits well with our observation that our participants were not afraid of customizing their smartphones and co-designing their user experiences. Our post-hoc interviews indicated that participants who had experiences with the Windows phones found both standard and customized interfaces very easy to use. Our participants put forward a lot of suggestions concerning both customizing layout and functions, including that: (1) a big tile (“ the big box”) is not beautiful when it “lives single on the desktop”; (2) colour issues were important; (3) style of icons could be improved; (4) animation effects should be able to be cancelled; (5) the index page (the long list of apps) is too long; (6) folder management should be better; (7) preview photo is too complicated when utilizing the camera app; (8) the highest frequency app is Wechat (for Chinese users) so it should come first; (9) closing the application is too cumbersome when adding new telephone number; (10) the add button is too small; (11) the weight of the mobile phone is too heavy, and; (12) the size is too big. From above, it is obvious that participants were not afraid or found it complicated, but instead, were rather creative and willing to customize both the composition and layout of apps on the smartphone for a better UX.

5.4 Limitations and Future Research

There are a couple of limitations with regards to this study. First, we found that layout customization was more important to smartphone users than functional customization. This is contrary to findings within extant literature on customization in which users are inclined to customize mainly for functionality purposes (Page, et al., 1996). Speculatively, this discrepancy in findings might be due to differences in our sample because we recruited participants located in China and studies have shown that Chinese users, in particular, tend to value aesthetics and system presentation (Frandsen-Thorlacius, Hornbæk, Hertzum, & Clemmensen, 2009). Future research could duplicate this study in other cultural settings in order to validate and refine our findings. In addition, researchers could also build on our findings and explore whether UX could be affected by language by comparing and contrasting effects of system customization across multiple languages (e.g., Chinese versus English).

Second, as the experimental study makes use of a Windows 7 smartphone (i.e., Nokia Lumia 900), we do recognize that the generalizability of our findings may be called into question when applied to other smartphones (e.g., Android and iPhone). Nevertheless, we are confident that our findings should hold across other smartphones because most, if not all, smartphones are designed for customization. Still, there is a necessity to replicate the experimental study for other smartphones in order to ensure the robustness of our findings. Moreover, we are also aware that the design of our experimental study focuses on participants’ initial contact with a smartphone. For this reason, there could be doubts as to whether our findings can be extrapolated to situations of continued usage. While we cannot rule out the possibility, we would like to highlight that in the context of smartphones, users share a tendency to continuously reconfigure the composition and layout of installed apps due to ever-changing needs. Therefore, there should not be major behavioural variations in users’ customization of smartphones in the stage of initial contact versus that of continuous usage.

6 Conclusion

The study verifies that customization culminate in users’ perceptions of system usability and flow experience, leading to engagement with a system. In this paper, we have advanced and validated the proposition that the relationship between customization and UX of a smartphone can be modelled as users’ beliefs about the system object (customization) that influence their attitudes towards the system object (perceived system usability), which in turn shapes their behaviour-based beliefs (flow) and attitudes (engagement) towards using the system. Manipulation checks confirmed that the customization task, in particular, layout customization was extremely pronounced for participants. Analytical results from the comparison tasks reveal that customization positively influences users’ evaluation of three key constructs of UX: perceived system usability, flow and engagement, and that the feeling of engagement is mediated via perceived system usability and flow. We thus recommend further studies of UX that delves deeper into the distinction between object- and behaviour-based beliefs and attitudes.

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