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Innovative user engagement and playfulness on adoption intentions of technological products: evidence from SEM-based multivariate approach

Saima Hussain[a], Sara Qazi[a], Rizwan Raheem Ahmed[b], Jolita Vveinhardt[c] and Dalia Streimikiene[d]

[a]Faculty of Management Sciences, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology, Karachi, Pakistan; [b]Faculty of Management Sciences, Indus University, Karachi, Pakistan; [c]Faculty of Economics and Management, Vytautas Magnus University, Kaunas, Lithuania; [d]Lithuanian Sports University, Institute of Sport Science and Innovations, Kaunas, Lithuania

ABSTRACT

Using ubiquitous computing devices, also UCD, is a conscious decision made by consumers, success of which depends on how much it involves and engages the user that results in functional, hedonic and social experiences in user's context and long-term success for organization. User engagement, tested in multifarious concepts, indicates that experiences that are significantly hedonic create an affective bond with the device and deliver high value to the consumer. This study verifies and investigates the dispositional and impacting factors that influence a consumer's adoption intention for radical or incremental innovation or loyalty to an incumbent ubiquitous computing device through concept of user engagement, self-congruity theory, innovativeness and playfulness. The research was based on a survey questionnaire collected from users of ubiquitous computing devices (UCDs) belonging to an educated urban population from an age group of 18 to 35 years residing in Karachi through convenience and self-selection sampling. In total, 654 complete responses were received coded in SPSS and the model was analysed through AMOS 23.0. Results indicate that three dimensions of user engagement are significant for ubiquitous computing devices (UCDs): focused attention, interaction appeal and perceived usability. The first two are significantly positive towards playfulness creating an association with self-concept leading to innovative consumer's innovation adoption and others having loyalty with incumbent device. The research theoretically contributes by identification of user engagement dimensions and significance of incumbent loyalty in innovation adoption phenomenon.

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CONTACT Dalia Streimikiene dalia.streimikiene@lei.lt

1. Introduction

1.1. Background of the research study

Ubiquitous computing devices (UCD) such as smartphones, phablets, tablets, smart watches and smart TVs are the most versatile devices allowing consumers to connect all around the world with great convenience. This trend of ubiquitous computing devices (UCDs) is not only seen in very tech-savvy highly developed countries but has also been witnessed in emerging and under-developed economies. Advancement in technology has created a plethora of ubiquitous devices and it is predicted that revenue from smart devices will reach $19 billion by 2018 (Jeong, Kim, Park, & Choi, 2017). Global Web Index Report indicates that almost 91% of the population in developed countries own a smartphone, 84% laptops, 40% tablets, 5% smart watch, and 1 in 10 digital consumers owns a wearable smart device (Mander & Katie, 2017). Prodigious evolution of ubiquitous devices is observed in Asian countries such as India, China and Indonesia, in comparison to Europe and America, indicative of nations that are at the forefront of technology and innovation. Pakistan being an emerging economy has also been experiencing a phenomenal growth in mobile phone subscribers that have increased from 14% of the population in 2005 to 80% of the population in 2017 (Sangi, Liu, & Samad, 2017). Smartphone penetration was recorded as 13% out of 127 million mobile phone subscribers in 2013 and raised to 40% out of 139 million mobile phone subscribers in 2017 (PTA, 2017) indicating trajectory growth in smartphone buyers with the numbers expected to increase by 7–10% each year (BusinessPlus, 2016). Adding to this, web traffic is also being mainly generated from smartphones, 70%, laptops, 27% and tablets, 3% signifying the widespread trend of ubiquitous devices among Pakistani consumers (Samaa, 2017).

Interestingly, rising trends in purchase of smartphones and adoption of smart gadgets helps technology based companies to predict post-launch sales of gadgets in emerging or under-developed markets. Latest indicators reveil that shipment of smartphones grew massively by 27.6% in 2017; consumers in Pakistan are following in the footsteps of consumers of developed countries, transforming their needs from feature phones to technology based innovative devices. This growth can be exponential and can fuel the demand for connected devices given a more stable environment, developed infrastructure, better data coverage and supportive data enabled services (IDC, 2017). The sales of smartphones have skyrocketed in the past year by 780%. The market is ripe for growth and adoption of ubiquitous connected devices, as another study displays the widespread trend for ubiquitous devices (News, 2016). Consumers are opting for devices that offer exuberance, peace of mind and desire fulfilment; with the practical and hedonic benefits of UCDs instigating users to become more dependent and stimulating obsessed behaviours by the users of all ages. UCDs are emerging with astonishing innovations giving birth to connected and complex ubiquitous media systems that allow consumers to interact and accomplish a multiplicity of tasks within the personal and professional space (Carillo et al., 2017) and are predicted to generate significant opportunities for businesses in various product categories (Jeong et al., 2017).

Researches of innovation adoption in connection with attributes of devices (Rogers, 2010), consumer perceptions (Davis, 1993), consumer attitude (Moore &

Benbasat, 1996), psychology (Hussain & Rashidi, 2015; Wozniak, Schaffner, Stanoevska-Slabeva, & Lenz-Kesekamp, 2017) and personality (Jeong et al., 2017; Rogers, 2010) have attracted prolific literature as the adoption of incremental and radical innovation of existing high-tech brands is a complex process that involves various stages such as knowledge, persuasion, decision, implementation and confirmation (Rogers, 2010). A consumer may accept the incremental/radical innovation or simply be inclined to continue using the incumbent models instead of switching to new ones (Lee & Park, 2016). Prolific literature suggests that an individual's personality traits such as innovativeness emphasised by Rogers (2010) and psychological influences such as user's engagement enforced by O'Brien and Toms (2008) are the most important traits in this regard. Consumer innovativeness is a tendency of an individual towards novelty and positive attitude towards innovation (Hirschman, 1980; Midgley & Dowling, 1978; Rogers, 2010). On the other hand, user engagement is a series of temporal interactions with a high-tech product, brand or organisation that creates trust leading to consumer loyalty (Hollebeek, 2011; Wiebe, Lamb, Hardy, & Sharek, 2014). Therefore, engagement is not an outcome; instead it is a process for crafting, constructing and increasing consumer relationship which subsequently leads to higher satisfaction, purchase intentions and product evaluation (Brodie, Ilic, Juric, & Hollebeek, 2013; Chung, 2015). A consumer using and interacting with a high-tech brand gets involved emotionally and psychologically (Phang, Zhang, & Sutanto, 2013) and believes to have achieved a balance between costs and benefits. A loyal and satisfied consumer feels a sense of belongingness and shows enthusiasm to learn more about new products, offers and benefits (Harrigan, Evers, Miles, & Daly, 2017). The continuance of using an incumbent device or adoption of new technology is solely dependent upon the level of behavioural, psychological and emotional engagement with the product that is triggered by brand satisfaction, trust, loyalty, brand promise and value (Fang, Zhao, Wen, & Wang, 2017). Consequently, user engagement is an experience that results from interaction with a high-tech device leading to behavioural outcomes due to hedonic flow, utilitarian interface and technology-task fit as perceived by the consumer (Cano, Perry, Ashman, & Waite, 2017) and provides a research foundation for computer and human interactions and outcomes.

UCDs companies are striving hard to increase market share, sales and visibility by introducing breakthrough technologies after immense research and development (Ritala & Sainio, 2014). Every year, not only new models of smartphones, tablets, phablets, notebooks, smart watches and TVs are introduced in the market with new configurations, technology, designs and options but newer and lower-cost companies also enter the market dumping low priced and throwaway products thereby creating strong competition (Zhang & Hou, 2017). An Apple report indicates that only 43% of current iPhone consumers consider buying newer models (Edwards, 2016). Therefore it is important to determine the effects of psychological needs (Lee, Chang, Lin, & Cheng, 2014; Wozniak et al., 2017) and personality factors (Koschate-Fischer, Hoyer, Stokburger-Sauer, & Engling, 2017) that lead to the ultimate acceptance of incremental or disruptive technology in the same product category, as failing to engage consumers means loss of sale, disloyal consumers and damaged reputation (Cano et al., 2017). As a result, this study in response to the stated problem, will

determine the role of consumer engagement, playfulness and innovativeness towards consumers' decision to adopt incremental and radical innovations of UCDs or loyalty towards the incumbent.

The objective of this paper is to determine the impact of user engagement on playfulness of UCDs; moreover, to ascertain the effect of playfulness on consumer's self-concept. We have also measured the effect of consumer innovativeness on consumer's self-concept. This paper also identifies the effect of consumer's self-concept on innovation adoption intention. Another objective of this study is to ascertain the influence of consumer innovativeness on innovation adoption intention. We have also examined the effect of user engagement towards playfulness leading to loyalty for incumbent UCD. This research contributes to the theory by identifying the significance of user engagement in the process of innovation adoption and the influence of psychological factors on loyalty towards incumbent device. Furthermore, previous literature has tested user engagement for online brand communities (Ibrahim, Wang, & Bourne, 2017), virtual shopping stores (O'Brien & Toms, 2008, 2010), mobile touch screen and apps (Cano et al., 2017), e-health (Comello et al., 2016), smartphones (Kim et al., 2013) etc., whereas this study is adding practical value by testing consumer engagement with ubiquitous computing devices (UCDs) that has not been tested earlier. This research is thus beneficial for marketers in developing effective marketing strategies for current users to adopt latest innovations.

The rest of the paper is structured as section 2 comprising the Conceptual frameworks and hypotheses formulations on the basis of previous literature; section 3 Methodology, section 4 Data analysis and results, section 5 Discussion, and section 6 Conclusions.

2. Conceptual framework and hypotheses on the basis of previous literature

Based on the literature of innovation adoption and user engagement, this study investigates the dispositional and impacting factors that influence a consumer's adoption intention for radical or incremental innovation or loyalty to an incumbent device. When a consumer who is a current user of an innovation is engaged with the brand, it affects the situational trait of enjoyment over a period of time contributing positively to hedonic benefits of that innovation. This ultimately leads to a sense of belongingness with the existing UCDs, either motivating an individual for innovation adoption of similar devices with radical or incremental innovations or creating a strong brand loyalty for the incumbent device that ultimately resists the adoption of incremental or radical innovation (Lee & Park, 2016; Woong-Kyu, 2016). Therefore, this study proposes a psychological model that depicts the positive influence of consumer innovativeness and engagement on the innovation adoption decision through the path of playfulness or hedonic benefits and theory of self-congruity (Byun, Dass, Kumar, & Kim, 2017). These findings will help marketers to enhance consumer engagement behaviour and recognize its strength for the success of incremental and radical UCDs. The research has potential to highlight unthought-of opportunities for Technology companies. Firstly, can analyze if their old gadgets are standing strong as a brand in

the market. Secondly, these companies can assess the best time to introduce radical or incremental innovation. Thirdly, they can effectively judge if there is a need to retain any functional or aesthetic attributes of the gadget, so an incumbent loyal can be transformed into an innovation adopter (Byun et al., 2017; Carillo et al., 2017).

2.1. Innovation adoption

An innovation is a novel product, service, idea or process that can change consumers' behaviours and life style. Innovation is currently observed at high rates in technological products, services, supply chain processes, packaging, sustainability strategies and entrepreneurship (Arts, Frambach, & Bijmolt, 2011; Rogers, 2010; Zhang & Hou, 2017). Innovation can be classified into three types, continuous, dynamically continuous and radical innovation. Continuous innovation neither influences the consumption patterns nor changes behaviours of the users whereas dynamically continuous and radical innovations are more prone to transform and revolutionise users' consumption patterns as well as personal, professional and social conducts (Hussain & Rashidi, 2015). Innovation adoption is a complex and multifaceted process, which involves dynamic stages and powerful factors at individual and organisational levels (Ritala & Sainio, 2014). The process initiates with product creation and ends at final adoption or rejection by consumers; organisations create sources of innovation and offer it to the market or consumers exposed to innovation mentally decide about accepting and adopting the innovation (Rogers, 2010). This process is inappropriate when innovation is not embraced by the end users or restricted to the innovators only (Mannan & Haleem, 2017). Consequently, researchers have been focusing on the issue of innovation adoption with highly fragmented literature focused on social system variables (Risselada, Verhoef, & Bijmolt, 2014), personality variables (Hussain & Rashidi, 2015), financial variables (Reinhardt & Gurtner, 2015), branding factors (Moons & De Pelsmacker, 2016), marketing factors (Risselada et al., 2014), environmental variables (Wisdom, Chor, Hoagwood, & Horwitz, 2014) and innovation related variables to increase an organisation's competitiveness, market share, brand image, profitability, revenues and growth (Reinhardt & Gurtner, 2015). Numerous researches on the diffusion of innovation have been carried out concentrating on particular aspects of the process and an a large number of these researches have identified consumer behaviour as the most important factor impacting the rate and course of innovation adoption (Jeong et al., 2017). For this reason, Hirschman (1980) emphasises that the choice of innovative products adoption differs from one individual to another, based on demographic (age, gender, location, etc.), socioeconomic (income, social class), psychographic (personal, situational and behavioural) and cultural (ethnic, value system) attributes.

2.2. Consumer innovativeness and innovation adoption

Acquiescence and adoption of innovation depends on the individual who may be an adopter or a rejecter of innovation and the innovation itself (Arts et al., 2011; Hirschman, 1980; Hussain & Rashidi, 2015). The trait of consumer innovativeness epitomises a latent desire for novel, diverse and innovative experiences and to adopt

new products, ideas, goods or services (Midgley & Dowling, 1978; Roehrich, 2004) and elucidates an individual who can be an innovator or a relatively early adopter of innovation in his/her communal system (Strutton, Lumpkin, & Vitell, 1994). Consumer innovativeness is an inherent personality trait that plays a pivotal role in innovation adoption. Innovators are segmented through theintensity of this specific trait as they are pioneers and act as opinion leaders of the innovation (Hussain & Rashidi, 2015). As innovators are the first ones to adopt innovations, they are highly motivated to identify the new high-tech products entering the market. An innovative consumer when exposed to incremental or radical innovation is more likely to adopt it, confirming that innovative consumers psychologically evaluate the innovation for self-congruence to consolidate their position as innovators and opinion leaders in the market (Aguirre-Rodriguez et al., 2012; Byun et al., 2017). Consequently the following hypothesis can be formulated based on literature:

H1: Consumer Innovativeness positively influences the intention to adopt Innovation.

2.3. Self congruity and innovative products

Self-concept has a plethora of defnitions in the literature of behavioural and social sciences; it is viewed as a unique bond that an individual has with his own self (, Feller, Tholen, Davidson, & James, 1980) or the concept of 'unitary-self' (Clark & Dirkx, 2000) subjugated with the literature of 'multiple selves' in social circumstances (Markus & Nurius, 1986). Diverse consumer studies have predominantly focused on four types of self-concepts; real, ideal, social and ideal-social (Byun et al., 2017; Kumagai & Nagasawa, 2016; Su & Reynolds, 2017). Diverse consumer studies have predominantly focused on four types of self-concepts; real, ideal, social and ideal-social (Byun et al., 2017; Kumagai & Nagasawa, 2016; Su & Reynolds, 2017). Real self-concept is how an individual perceives oneself; ideal self-concept is how a consumer would wish to see oneself; social self-concept is individual belief of how others perceives him/her and ideal-social self-concept is how an individual would wish to be perceived by others (Byun et al., 2017). Sirgy (1982) proposes that individuals psychologically match the product with their self-concept; a high degree of self-congruence leads to a favourable assessment of the product resulting in the final purchase behaviour (Antón, Camarero, & Rodríguez, 2013). Self-concept is a psychological mechanism that triggers with the awareness and exposure of the product, idea, concept or service (retail patronage). The hedonic and utilitarian benefits of the product in congruence with the self-concept may create positive biases towards the product. Likewise it can be assumed for innovative products, a consumer exposed to innovation or newness processes the information psychologically to develop self-congruence with the product image. Thus a researcher would insinuate the verified conjecture (Byun et al. (2017))

H2: Decision to adopt innovation is affected by consumers' self-concept. The congruence between innovation and self-concept will more likely result in adoption of the innovative offering.

Bearing in mind the ideal self-concept and social ideal self-concept, an innovative consumer who continually opts for innovation is a pacesetter striving to maintain

his/her image as an opinion leader in social circumstances (Jeong et al., 2017). Therefore, the innovativeness trait of a consumer favours symbolism of self-image and innovative product image leading to favourable attitude towards the innovation (Byun et al., 2017). Thus the study verifies the following hypothesis:

H3: Consumer innovativeness impacts the congruence between self-concept and innovative product.

In contrast,, a consumer who is already a user of innovation may psychologically reject the innovation due to self-congruity and find the incumbent device more attractive than the alternate innovation. A consumer may perceive quality, symbolism and benefits of incumbent to be superior due to relative advantage, (Booyzen, Marsh, & Randolph, 2017); Lin, Huang, and Hsu (2015) and is inclined to be more loyal towards the present device (Booyzen et al., 2017; Janita & Miranda, 2013; Rambocas & Arjoon, 2012). Thus, a researcher can infer that self-congruity can impact loyalty towards incumbent due to the relative advantage of the innovative product.

H4: Loyalty towards incumbent is causation of individual's self-concept.

H5: Influence of self-congruity on innovation adoption is controlled by loyalty with the incumbent technology.

2.4. Hedonic stimulation

Hirschman and Holbrook (1982) characterised hedonism as consumer behaviour that relates to multisensory, imaginary and emotive facets of experiences with the product (Alba & Williams, 2013). Hedonic stimulation is associated with the pleasure of experiencing a technology-based product; the user benefits involve motivation, playfulness and joy of exploring novelty (Abdul-Ghani, Hyde, & Marshall, 2011). Hedonic benefits are positive emotions towards an innovative offering resulting from the appreciation of an experience. An innovative product user who has positive experience with the current innovation shows positive emotions and appreciation towards the incremental or radical innovation. Hedonic values such as playfulness can be defined as predilection towards pleasure and enjoyment from involvement in activities (Byun et al., 2017). Playfulness increases intrinsic satisfaction and involvement in the product. Consumers tend to enjoy the product for intrinsic enjoyment rather than extrinsic rewards (Hernandez & Handan, 2014). Consumers are actively involved, cognitively spontaneous, and curiously inventive to play with the idea (MacKinnon, 1962). Likewise Byun et al. (2017) elaborate playfulness as an intrinsic motivator that provides satisfaction from novel experiences and individuals tend to perform tasks and activities for sheer enjoyment apart from the performance repercussions. Playful consumers are creative, open-minded, flexible, accepting towards novelty, tweak their self-concept and are more likely to have high congruence of novelty with self-image (Müller-Stewens, Schlager, Häubl, & Herrmann, 2017). Therefore, playfulness of a consumer increases the value of innovation in contributing positively towards self-concept and innovative product image (Byun et al., 2017; Marin, Reimann, & Castaño, 2014).

H6: Playfulness has a positive effect of self-concept in relation to innovative product.

2.5. Impact of user engagement

User engagement is a human and computer interaction concept that is a combination of positive emotions, behavioural, cognitive and affective responses and quality experience when interacting with computing devices (O'Brien & Toms, 2008, 2010; O'Brien & Toms, 2013). Correspondingly, the research of Kim et al. (2013) in line with Rosenberg, Hovland, McGuire, Abelson, and Brehm (1960) classifies human interaction components into cognition, affection, and conation. Cognitive responses are user driven needs of the technology such as ubiquity, connectivity on the go, etc. Affective responses are the feelings of a user towards the technology-based product that basically triggers hedonic consumption of the UCD. Conative responses are the likelihood of users' actions, intentions and behaviours (Kim, 2017). User engagement is the result of first user interaction with the computing device trailed by profounder absorption that leads to behavioural outcomes (Bellur & Sundar, 2017), which provide a succinct lens for understanding human computer interaction. User engagement is further classified into six dimensions for computing devices by O'Brien and Tom (2013): 1) Aesthetics, 2) Focused Attention, 3) Endurability, 4) Involvement, 5) Novelty, and 6) Usability based on Aesthetic, Play and Flow theories. Dimensions of user engagement indicate that users engross with the device based on visual appeals, fit between task and technology, recommendations to others, cognitive immersions, temporal flow, environmental dissociation, pleasure, newness and affective experience during usage (Cano et al., 2017; O'Brien & Toms, 2008, 2010; O'Brien & Toms, 2013) as indicated by Table 1.

User engagement dimensions are already tested in literature for mobile phones (Kim et al., 2013), online websites (O'Brien & Toms, 2013), 3D and 2D interaction effects (Visinescu, Sidorova, Jones, & Prybutok, 2015), touch screen interactivity (Cano et al., 2017), online health programmes (Comello et al., 2016) and online reading (O'Brien & Toms, 2010). These researches indicate that user engagement does influence the psychological needs and customer satisfaction. Using UCDs is a conscious decision made by consumers, success of which depends on how much it involves and engages the user that results in functional, hedonic and social experiences in a user's context and long-term success for organisations (Harter, Schmidt, & Hayes, 2002). Ubiquitous devices are particularly appreciated and adopted by the consumers as they are readily available and allow 24/7 connectivity with the internet (Cano et al., 2017; Kim, 2017). Prolific literature indicates that user engagement experiences that are significantly hedonic i.e. fun, playful and enjoyable, create an affective bond with the device and deliver high value to the consumer (Davis, Bagozzi, & Warshaw, 1992). Additionally, continued usage in post-adoption lifestyle depends on

Table 1. Dimensions of user engagement.

Concept	Meaning
Aesthetic	Perceived visual appearance of a mobile device interface
Endurability	Perceived success, recommend to others, users' likelihood to reuse
Involvement	Users' feelings, interest, and having fun during the interaction.
Focused Attention	The absorption of mental activity
Novelty	Users' level of interest in the task and curiosity evoked by the system and its contents.
Perceived Usability	Users' affective and cognitive response to the device.

Source: (O'Brien & Toms, 2008, 2010, 2013).

the affective engagement motivation after initial adoption (Cano et al., 2017; Kim et al., 2013; O'Brien & Toms, 2013). This leads to the development of the following hypothesis:

H7: Playfulness will be stronger when users are more engaged with the ubiquitous computing devices.

3. Methodology

3.1. Measurement scale and sample

The survey questionnaire wasdesigned to analyse consumers' innovation adoption behaviour for ubiquitous media devices through user engagement, playfulness, self-congruity, innovativeness, and loyalty with incumbent and decision to adopt innovation. Questionnaire had screening questions to gauge if respondents are true users for ubiquitous devices, leading to the statements of gadget appeal, fun, involvement, absorption, interest, aesthetics, usability, adoption intentions and bonding with current device. The data was collected from the students of different private universities at undergraduate, graduate and postgraduate level. The survey questionnaires were printed and distributed in various classrooms and conferences at universities. The researcher also sent online form links to the members of research community groups on social media. We have used purposive sampling technique in order to fulfil the purpose of the study. Pilot testing was performed on data of 100 respondents and Cronbach's alpha was $>.8$ for all concepts except Loyalty with incumbent – found to be $>.7$; composite reliabilities for all constructs was $\geq .7$ and discriminant validity was tested through Fornell and Larcker's test where square root of AVE $>$ correlations among all constructs (Fornell & Larcker, 1981). The researcher then collected final data, total number of responses received were around 672. The researcher then coded the data in SPSS 21.0; responses with more than 20% missing values were deleted, other missing values were replaced with mean estimation based on Little MCAR test (Hair, Black, Babin, & Anderson 2010); itr was found to be significant that all missing values were at random. Outliers were analysed through Mahalanobis in AMOS SEM and 12 responses were deleted as they were potential outliers (Hair, Gabriel, & Patel, 2014).

3.2. Research design

The research aims to investigate and verify impacts of personality, situational and behavioural trait on intention to adopt innovation or incumbent's brand loyalty with interplay of self-concept, based on epistemology of post-positivism as it seeks objectivity through logical reasoning and has controlled structure of methodology with inductively constructed hypothesis for verification or falsification (Saunders, Lewis, & Thornhill, 2009). The research is based on mono method survey strategy. Data collection is cross-sectional and Structure Equation Modeling (SEM) is applied for data analysis. The research targets consumers who are current users of any high-tech ubiquitous gadget such as smartphone, tablets, phablets, smart watch and smart TVs within the age group of 18 to 34 years residing in urban Karachi with at least tertiary level of education with comprehension of English language statements as the

questionnaire is not translated in any other language; the population is consistent with literature recommendations and testing by Kemp (2017) report and Hussain and Rashidi (2015). SEM analysis suggests that data must be >250 with factor loading >0.6 for each observed factor; therefore the researcher is opting for 500 sample size based on model complexity and large number of observed variables (Hair et al., 2010). The data is collected through a structured questionnaire adopted and tested in the literature of User Engagement (Cano et al., 2017), Consumer Innovativeness (Byun et al., 2017), Playfulness (Byun et al., 2017), Self-Congruence (Byun et al., 2017), Adoption Intention (Al-Debei & Al-Lozi, 2014) and Loyalty with Incumbent (Woong-Kyu, 2016).

4. Data analysis and results

4.1. Demographic profile of respondents

Total numbers of responses analysed were 654; they were all the students from private sector universities in Karachi enrolled invarious programmes. The average age of the sample is 23.7 years with 60.6% males and 39.4% female respondents and almost 69% belonging to middle and upper middle class with monthly household income >150,000 PKR (Pakistani Rupee). On average, all respondents were aware and using these ubiquitous devices for six to ten years. Table 4.1 further provides UCDs profile of the respondents

4.2. Exploratory factor analysis

The researcher examined dimensionality of 58 items belonging to eight variables through principal component analysis with Varimax rotation. KMO statistics value is 0.96 indicating compact correlational patterns and significant test proves the adequacy of factor of analysis. Moreover, based on Eigen value 8 components are displaying approximately 63.38% variance explained as indicated in Table 2. Items sharing high variance were combined; in contrast, items with low factor loading <0.6 and high cross loading >0.4 were deleted (Hair et al., 2010). The concept of User engagement with 31 questions and six dimensions was reduced to three dimensions indicated in Table 3. Visual Appeal and Novelty were merged due to high correlation,

Table 2. KMO Measure of Sampling Adequacy and Total variance explained

KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy			.961
Bartlett's Test of Sphericity	Approx. Chi-Square		27094.860
		df	1653
		Sig.	.000

Initial Eigenvalues			
Components	Total	% of Variance	Cumulative %
1	18.926	32.630	32.630
2	7.381	12.726	45.356
3	3.573	6.161	51.517
4	1.967	3.392	54.909
5	1.563	2.695	57.604
6	1.207	2.080	59.684
7	1.129	1.947	61.632
8	1.015	1.750	63.382

Extraction Method: Principal Component Analysis

Table 3. Rotated factor loading.

Playfulness		Interaction Appeal		Focused Attention		Perceived Usability		Innovativeness		Self-Congruity		Incumbent Loyalty		Innovation Adoption	
q1	.838	q9	.636	q18	.758	q32	.742	q41	0.841	q45	.673	q50	.613	q54	.821
q2	.843	q10	.728	q19	.626	q33	.839	q42	0.652	q46	.717	q51	.820	q55	.799
q3	.902	q11	.769	q21	.768	q34	.841			q47	.719			q56	.783
q4	.810	q12	.727	q22	.754	q35	.753			q48	.665			q57	.730
q5	.788	q13	.676	q25	.646	q36	.732			q49	.702			q58	.723
q6	.875	q14	.678	q26	.751										
q7	.882	q15	.682	q27	.724										
q8	.821	q16	.657	q28	.710										
				q29	.748										
				q30	.701										
				q31	.648										

therefore the researcher named combined variable as Interaction Appeal. The hypothesis H7 will be redeveloped in the following three sub-hypotheses:

H7a: Playfulness will be stronger when users have more focused attention with ubiquitous computing devices.

H7b: Playfulness will be stronger when users have interactional appeal with the ubiquitous computing devices.

H7c: Playfulness will be stronger when users have more perceived usability with the ubiquitous computing devices.

4.3. Validity and reliability

Structural Equation Modeling method was used for the analysis of measurement and structural model. Since multiple items were measuring a construct, therefore to test the appropriateness of the instrument reliability, composite reliability, convergent validity and discriminant validity, was tested before model testing. Convergent validity has already established through Exploratory Factor Analysis; items are only considered if loadings >.6, furthermore Table 4 indicates descriptive statistics, composite reliabilities and average variance extracted. Cronbach's alpha for all the construct is greater than 0.8 except for incumbent which still lies in the acceptable range of greater than 0.6. Fornell and Larcker's composite reliabilities have a benchmark of above 0.7 for all the constructs indicating average variances of above 0.5.

The AVE is also used to evaluate discriminant validity using Fornell and Larcker's method that is comparing whether the square root of AVE is greater than correlations between each pair of constructs for all relevant constructs (Fornell & Larcker, 1981). Table 5 indicates that each set of construct has correlation less than the AVE, which is shown in Table 4 that established the discriminant validity for all the constructs.

4.4. Common method bias testing

The data received from the respondents may have biasness that is tested through two approaches as mentioned by Kim et al. (2013). First, by examining correlation mentioned in Table 5, if there is any correlation greater and equal to 0.9, it is strong evidence for biases in the data. Correlation's highest value is 0.81, which is less than 0.9 indicating common bias is less likely to exist. The second approach requires the inner VIF values of the constructs <–3.3 (Kock, 2015), therefore Table 6 indicates that inner VIF values for all relationships among constructs <3.3 indicating common bias is less likely to exist.

Table 4. Descriptive and reliability measurements for variables.

	Mean	SD	Cronbach's Alpha	Composite Reliability	AVE
Focused Attention	3.3106	1.30826	0.909	0.926	0.61
Interaction Appeal	2.9366	1.35491	0.951	0.958	0.695
Perceived Usability	3.7648	1.36381	0.906	0.93	0.728
Playfulness	2.8445	1.39077	0.952	0.96	0.75
Innovativeness	3.6642	1.48548	0.710	0.872	0.774
Self-Congruity	3.2870	1.04330	0.824	0.876	0.587
Incumbent	3.4270	1.26343	0.664	0.854	0.746
Innovation Adoption	3.3548	1.36994	0.855	0.895	0.632

Table 5. Discriminant validity measure.

	Focused Attention	Incumbent Loyalty	Innovation Adoption	Innovativeness	Interaction Appeal	Perceived Usability	Playfulness	Self-Congruity
Focused Attention	**0.781**							
Incumbent Loyalty	0.199	**0.864**						
Innovation Adoption	0.239	0.272	**0.795**					
Innovativeness	−0.13	0.267	0.455	**0.88**				
Interaction Appeal	0.627	0.155	0.259	−0.309	**0.834**			
Perceived Usability	−0.172	0.193	0.072	0.51	−0.531	**0.853**		
Playfulness	0.6	0.151	0.273	−0.291	0.81	−0.485	**0.866**	
Self-Congruity	0.401	0.403	0.558	0.295	0.457	−0.033	0.435	**0.766**

The bold values are the correlation of construct itself, otherwise, all other values indicates that each set of construct has correlation less than the AVE.

4.5. Structural model testing

The proposed hypothesis of the research was tested through AMOS 21, a covariance based SEM more robust for large sample size data and appropriate for theory verification or confirmatory researches. Normality tests cannot be assessed due to large sample size; however, the skewness and kurtosis for all items are in the range of −3 to +3 for skewness and −7 to +7 for kurtosis as suggested by Kline (2015) for multivariate normality in complex models with sample sizes greater than 400.

Structural Equation Modeling fit indices show chi-square 86.670 with df 14; the model was tested for fitness with the inclusion of respective intervening and dependent variables that are showing high modification indices which meet the acceptable ranges prescribed by Hair et al. (2014) and represent a good model fit in Table 7.

As shown in Figure 2, two dimensions of user engagement, i.e. focused attention and interaction appeal is positively affecting playfulness with β values of .074 and .828 at p-value $\leq$ 0.000, while perceived usability has no significant effect on playfulness. Ubiquitous device users' playfulness and innovativeness affects their self-image positively with β values of .434 and .487 at p-value $\leq$ 0.000. In addition, self-image is leading to loyalty with incumbent device or innovation adoption with β of .476 and .487 at p-value $\leq$ 0.000. The researcher further updates the model and tested connection of perceived usability with dependent variables. Therefore, it was evident that perceived usability is significantly connected with incumbent loyalty with β value of .209 at p-value $\leq$ 0.000

Path analysis indicates that innovation adoption is stronger than loyalty with incumbent. The researcher further modified the model to check if perceived usability has any significance in the model or not. Model adjustment indicates that perceived usability has positive effect on loyalty with incumbent and R Square for incumbent loyalty increased from 16% to 21% (see Table 8). In parallel, Hypothesis 7 moderation testing of incumbent loyalty was not supported on the effect of self-congruity towards innovation adoption.

Table 6. Inner VIF values for the model.

	Incumbent	Innovation Adoption	Playfulness	Self-Congruity
Focused Attention			2.013	
Incumbent				
Innovation Adoption				
Innovativeness	1.125	1.125	1.756	1.176
Interaction Appeal			2.861	
Perceived Usability			2.333	
Playfulness				1.176
Self-Congruity	1.125	1.125		

Table 7. Overall model fit summary.

Chi-square	86.670 Degrees of freedom = 14
GFI	.969
AGFI	.920
IFI, TLI and CFI	.969 .937 and .969
RMSEA	.08

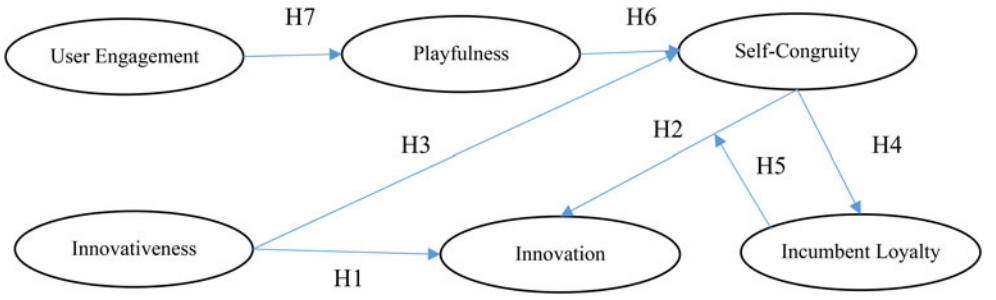

Figure 1. Theoretical Framework (Byun et al., 2017).

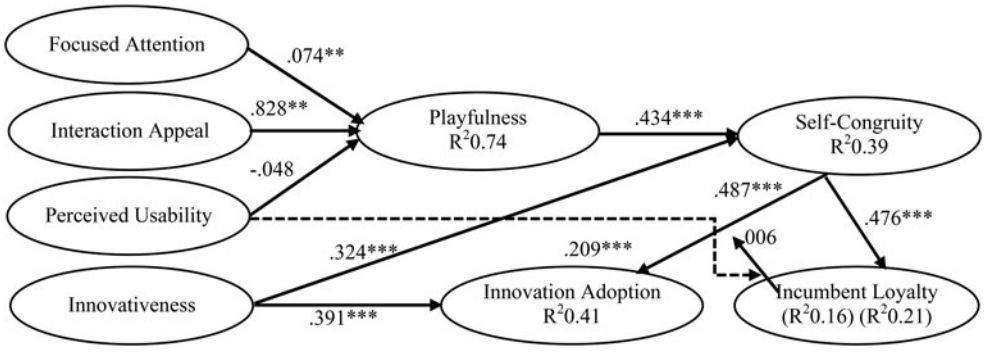

Figure 2. Structural equation modeling path coefficients.

Table 8. Path coefficients.

Hypothesis				Estimate	P
H7a Supported	Playfulness	<—	Focused Attention	.074	.002
H7b Supported	Playfulness	<—	Interaction Appeal	.828	***
H7c Not Supported	Playfulness	<—	Perceived Usability	−.048	.052
H3 Supported	Self-congruity	<—	Innovativeness	.324	***
H6 Supported	Self-congruity	<—	Playfulness	.434	***
H2 Supported	Innovation Adoption	<—	Self-congruity	.487	***
H4 Supported	Incumbent Loyalty	<—	Self-congruity	.476	***
H1 Supported	Innovation adoption	<—	Innovativeness	.391	***
Modified H7c	Incumbent Loyalty	<—	Perceived Usability	.209	***
H5 Not supported	Innovation Adoption	<—	Moderation	.006	.873

5. Discussions

The paper verifies the existing model of Byun et al. (2017) along with significant theoretical and practical contribution. Research has opted to understand innovation adoption phenomenon along with consumers under researched behaviour of loyalty with incumbent devices in congruence with their self-concept that amplifies the effect between independent and dependent variables. Concept of user engagement is psychological construct that is tested for ubiquitous devices, indicating strong presence in the phenomenon of innovation adoption as well as incumbent loyalty. In theoretical perspective the study has proposed reduced dimensions of user engagement for ubiquitous devices that is focused attention, interaction appeal and perceived usability, interaction appeal being the strongest predictor for engagement and has already

been tested as need for handling under psychological needs for interactive devices (Cano et al., 2017). Secondly, by verifying the role of self-image via theory of self-congruence as amplifying effect for innovation adoption (Byun et al., 2017) and testing it for loyalty with current incumbent devices. Likewise, loyalty with incumbent devices (Woong-Kyu, 2016) is tested as a strong contribution in the framework which appears to be strongly significant with self-concept as well as perceived usability dimension of user engagement; therefore, if consumer had frustrations and efforts in engaging with the device it is possible that he may avoid switching to new one soon. We hope that further refined frameworks will be developed to test other factors that significantly influence this variable. Lastly the study once again verified the trait of innovativeness to be the strongest predictor for innovation adoption (Hussain & Rashidi, 2015; Jeong et al., 2017; Koschate-Fischer et al., 2017). Finally, the results provide strong evidence of user engagement effecting creativity and enjoyment of users and innovativeness trait creates curiosity towards novel devices and the consumer finally develops a mental congruence with the offered device and his self-concept may opt for innovation adoption or stay with their current device.

5.1. Managerial implications

In practical perspective the framework provides a new insight about interaction appeal to the marketer, if the device has marvellous aesthetics, incredible visuals and novel attributes it engages users creating a favourable playful response towards the device, the user initiates associating the device with their self-image that intensifies their propensity to adopt novel devices with incremental or radical innovation provided that the consumer has strong traits of innovativeness. Therefore, for new devices, marketers need to profile consumers based on their playfulness and innovativeness to generate substantial favourable response. The novel device must have improved interaction appeal that satisfies sensory needs of touch positively influencing psychological traits resulting in positive response towards innovation adoption. This research also confirms that in comparison with product's functional attributes psychological playfulness, innovativeness, self-concept also play important roles to convert potential buyers into adopters; however, if a user faced a lot of effort and frustrations in learning about a device he/she is more likely to stay with their current device rather than adopting a new one and go through that annoyance of learning the new device. Therefore, marketers may find a way to improve learning experiences by focusing on perceived usability factor if they wish consumers to switch their current devices with new ones.

Marketers and designers of the innovation need to:

- Deploy strategies to reduce learning time of new devices for consumers to adopt innovation
- Touch screen interaction and visual experience is extremely important for a consumer to enjoy and indulge in the device. Therefore every device innovation must offer improved interactivity experiences.

- Consumers can be motivated for innovation adoption by displaying fun, absorption, and creativity. Marketers may display these attributes to increase the propensity of radical or incremental innovation adoption.
- Market segmentation for novel devices need to be more psychological than demographic as the innovative and playful consumer does associate novelty with their self-image.

6. Conclusions

This research examined how user engagement is related to playfulness, self-image while using ubiquitous computing devices. In addition the research tested effect of these factors on loyalty with incumbent device or their favorite device. Data was collected through asurvey that provided significant insights about consumer psyche and decision to adopt innovation (1) consumer engaged with ubiquitous devices feels playful due to interactive capabilities of the device, therefore screen interactivity needs to be strongly appealing for the consumer to enter into the innovation adoption phenomenon, (2) if consumers have had cognitive and affective learning experience while using the device they are more likely reluctant to adopt novel products, (3) innovativeness is the most important trait in the process of innovation adoption and (4) when consumer associate a device with their self-image then it does influence their loyalties towards that incumbent.

6.1 Limitations and suggested areas of further research

Our research is limited due to methodology of self-report survey based research and non-probability sampling that restricts the generalisation of the data. Therefore further researches may be done in an experimental environment or through galvanic response sensors to gauge user engagement with the ubiquitous device. Loyalty with incumbent devices has been prove to exist and consumers do not opt for incremental or radical innovation in all cases; therefore this research provides a foundation for supplementary research on framework development on incumbent loyalty so that marketers can understand and minimise them for persuasion of innovation adoption.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1. Questionnaire

	Statement	Reference
1	Using this device stimulates my creativity	(Byun et al., 2017)
2	Using this device stimulates my curiosity	Playfulness
3	Using this device leads me to explore	
4	Using this device arouses my imagination	
5	Using the product makes me feel open-minded	
6	Using this device for tasks gives me enjoyment	
7	Using this device for tasks is fun for me	
8	Using this device for tasks makes me happy	
9	I lost myself in this device.	(Cano et al., 2017),
10	I was so involved in this device that I lost track of time.	User Engagement
11	I blocked out things around me when I was using this device	
12	When I was using this device, I lost track of the world around me.	
13	The time I spent using this device just slipped away.	
14	I was absorbed in these device apps.	
15	During device using experience I let myself go.	
16	I was really drawn into my device apps.	
17	I felt involved in this device.	
18	This device experience was fun.	
19	I continued to use this device out of curiosity.	
20	The apps of this device prompted my curiosity.	
21	I felt interested in this device.	
22	Using this device was worthwhile.	
23	I consider this device part of my success.	
24	This device did not work out the way I thought.*	
25	This device usage experience was rewarding.	
26	I would recommend my favorite device to my friends and family.	
27	This device is attractive.	
28	This device is aesthetically appealing.	
29	I liked the graphics and images of this device.	
30	This device appealed to my visual senses.	
31	The device screen was visually pleasing.	
32	I felt frustrated while using this device.*	
33	I found this device confusing to use.*	
34	I felt annoyed while using this device.*	
35	I felt discouraged while using this device.*	
36	Using this device was mentally challenging.*	
37	This device shopping experience was demanding.*	
38	I felt in control of this device.	
39	I could not do some of the things I needed to do on this device.*	
40	Compared to my friends, I frequently change my device with a new device	(Byun et al., 2017) Innovativeness
41	In general, I am among the first in my circle of friends to buy a new device when it appears	
42	I will buy a new device, even if I have not heard of it yet	
43	If I heard that a new device was available in the store, I would be interested enough to buy it	
44	I know the names of new devices before other people do	
45	The image of this new device is very similar to the kind of person I am	(Byun et al., 2017) Self-Congruity
46	The image of a typical user of this new device is highly consistent with how I see myself	
47	I have something in common with people who use the latest device	
48	People similar to me would own this device	
49	I can identify with people who would prefer this new device to older ones	

(*continued*)

Continued.

	Statement	Reference
50	I intend to rebuy and continue using current device rather than discontinue its use	(Woong-Kyu, 2016) Loyalty Incumbent
51	My intentions are to rebuy and continue using current device rather than buying latest one	
52	If I could, I would like to discontinue my use of my current device	
53	If I could, I would like to switch from the current device to a latest one	
54	I would buy new device when it is launched	(Al-Debei & Al-Lozi, 2014) Adoption
55	I would actively seek out the latest device for purchase upon launch	
56	I would purchase the device as soon as it is available	
57	I would recommend my friends to buy Latest device	
58	I would consider buying a latest mobile device	