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Research Article

Persuasive System Design Principles that Impact the Usability of Smartphone Applications

Serri Faisal[1] and Ghassan Al-Qaimari[2]

[1]Applied Engineering College/Lincoln College, Riyadh, KSA

[2]Emirates College of Technology, Abu Dhabi, UAE

Correspondence should be addressed to: Serri Faisal; serri.faisal@gmail.com

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Abstract

The study examines the impact of persuasive system design principles (PSD) on the continued use of WhatsApp users. A cross-sectional survey was employed to collect data from 488 participants living in Germany, the Kingdom of Saudi Arabia, the Netherlands, and Malaysia, representing varying cultural backgrounds. This study employed one-way ANOVA, multiple regression analysis, and Tukey's HSD test for analyzing the data. Findings indicate that PSD with varying effects of its elements is a factor influencing customer loyalty regardless of cultural effects. This suggests that businesses can influence consumers globally by going beyond specific designs for local cultures and by adopting PSD principles within their design, hence a lower cost and faster reach to culturally-different markets

Keywords: Persuasive system design, internationalization, HCI, user loyalty.

Introduction

While the market for Smartphone applications (apps) is competitive, app loyalty is a constant concern for developers and vendors. Only one in five smartphone apps are downloaded more than 1,000 times; and for every four downloaded applications, at least one has never been used (Hoehle et al. 2015). The success of globally popular apps, such as WhatsApp, will be undermined if user loyalty cannot be sustained. With competitors (e.g. Line, WeChat, and Snap Chat) attempting to imitate the persuasive design of WhatsApp, investigating the factors that influence user loyalty to software applications across cultures is a paramount issue for designers. Such factors can reduce the cost, effort, and

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time to design and develop apps for users across the globe.

Few studies exploring Smartphone apps' loyalty across different cultures have integrated Hofstede's espoused cultural dimensions into a model that investigates the impact of Smartphone social network application usability on post-adoption behavior (O'Hara et al. 2014; Church & de Oliveira 2013; Choi et al. 2013; Hoehle et al. 2015). However, the evidence from the past decade demonstrates that globally popular apps can supplant local variants. For example, Mixi, a Japanese social networking site (SNS), in 2008, was the fifth most visited website in Japan, while Facebook did not even enter the top 100 (Fogg & Iizawa 2008). Mixi was more popular than Facebook because Mixi's persuasive design was better suited to Japanese culture. However, by December 2014 the tables were turned: Mixi ranked 31st most popular site in Japan, while Facebook rose to eighth. In May 2018, Facebook's popularity in Japan was still high, seventh on the rank list (Alexa, 2018). Choi et al. (2013) observed a developing shift from local to global SNS: The divide of technological acceptance between different cultures narrowed (Choi et al. 2013). This trend suggests that research is needed to understand why certain Smartphone apps are globally successful, despite cultural factors not being considered in their design.

Persuading Smartphone users from different cultures to adopt and sustain their interest in using apps is important to any designer. This paper seeks to fill a gap in the literature by investigating the impact of PSD on customer loyalty in different countries. Fogg (2003) and Oinas-Kukkonen and Harjumaa (2009) has developed structured guidelines for designing persuasive systems; however, empirical studies testing the design theory are still lacking. The PSD principles are well-structured and serve as a requirement checklist for designers to implement in the persuasive system (Oinas-Kukkonen & Harjumaa 2009). Nevertheless, they do not address loyalty from users' perspective – central to identifying if the system achieves the goals of persuasiveness. As opposed to most Human-Computer Interaction studies relying on designers' perspective, this study has developed and used an instrument that measures loyalty from users' perspective.

The research question of the study is "What is the impact of PSD principles of apps design on loyalty?" Based on Oinas-Kukkonen and Harjumaa's PSD model (2009), the research examines the impact of PSD principles on loyalty to Smartphone apps in four different countries with varying cultural spectrum.

Human-Computer Interaction (HCI) and Usability

Human-Computer Interaction (HCI) is the study of interaction between people and computers (Zhang 2004). HCI has been studied in many disciplines, including behavioral science, computer science, software design, and graphic design (Grudin 2005). As asserted by Carroll, HCI is a science of design (Carroll 1997). The principle aim is to design systems that are usable and acceptable for users. This science "seeks to understand and support human beings interacting with and through technology" (Carroll 1997). However, the design must be convenient to use, as intended by the designers and beneficial as perceived by end-users. Moreover, HCI design should principally be effective, efficient, engaging, error tolerant, and easy to learn (Fallman & Waterworth 2010).

Usability is a very important area of HCI. According to the International Standards Organization, ISO 9241-11 (1997), usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." Effectiveness refers to the accuracy and completeness with which users achieve specified goals. Efficiency refers to the resources (time, money, mental effort etc.) expended in relation to the accuracy and completeness with which users achieve goals. Satisfaction refers to freedom from discomfort, and positive attitudes to the use of the product. Context of use refers to the users, goals, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.

The challenge for the usability specialists at every stage of the development process is conducting the most appropriate usability evaluation technique for assessing the usability requirements of a software system. These evaluation techniques range from applying HCI design guidelines and principles, to applying usability analysis techniques, to testing the usability with the help of representative users.

Cultural Models and HCI

In continuous attempts to espouse cultural models to HCI, researchers have applied culture as a tool to aid design frameworks. Yeo (1996) has proposed an approach, cultural user interfaces, for making user interfaces culturally compatible. Like most other researchers in the cultural HCI field, Yeo has further suggested using culturally-fit images and non-functional components that are customized according to the local culture (Yeo 1996).

Al-Qaimari, in 2005, proposed a practical user-centered design and development lifecycle for building global software applications that support multiple locals (Al-Qaimari 2005). The proposed lifecycle utilizes the process of internationalization and localization. Internationalization refers to the culture-independent component of the design, while localization refers to the culture-dependent component. The culture independent component, known as the basic template, contains the greater part of the website, or the app, and is devoid of culture sensitive elements. Localization, on the other hand, is defined as the process of providing the culture-dependent component of a particular target culture (specific locale). To ensure the usability and acceptability of applications designed for the global market, the proposed design and development lifecycle emphasizes the need to test both components with the help of representative users from the targeted locals.

App designers typically used Hofstede's model along with other cultural models to explain or frame the cultural differences (Marcus & Page 2011). While significant works exist in the field of cross-cultural HCI, most efforts to apply cultural models to HCI are limited in their scope, either because of limitations in sample size, or because of inadequate testing or verification. Some have even yielded conflicting results (Wu 2006).

Internationalization of Technology

As smartphone apps became a global phenomenon, researchers from all over the world are increasingly investigating HCI from a cross-cultural perspective. This requires the consideration of usability and internationalization within the apps design. Internationalization is the unified design of software for a global user community, modified for different regions (or cultures) globally. Such designs allow easy adaptation (or localization) for an appropriate language. This approach allows a modification of terminology to suit a specific cultural context and change the user interface accordingly. Internationalization also helps minimize the time spent on adding new features and fixing errors in the localized software (Shen et al. 2006). Internationalization design includes allowing for changing date and time formats, layout adaptation, images and color schemes to suit a particular country, region, or culture. For an application to be culturally successful, usability principle must be present throughout the process of internationalization.

Most of the recent research studies, based on cultural characteristics are concerned with adapting an application's interface, terminology and hierarchy of functions to a particular culture (Fogg & Iizawa 2008; Marcus & Page 2011). Most of these studies have used cultural differences to adapt applications for different cultures, modifying the same application as many times as the number of targeted cultures. Although these studies can principally be applied to other computing platforms, little research has been specifically conducted on the design of smartphone apps, with smartphone app users' acceptance in mind. Moreover, limited attention has been given to compiling the similarities of cultures to produce an application. These similarities include the common denominator(s) among the cultures. If these cross-cultural factors are addressed, application design

internationalization can be limited to localizing language, date and time formats, and images, saving cost and effort.

Although the literature includes different approaches for applying HCI to the internationalization of software applications (Al-Qaimari 2005), a consistent approach is needed for designing an application for the cross-cultural market. To contribute to research on HCI, this study investigates the employment of persuasive design principles as a one-iteration development process to support usability and internationalization, followed by a localizing process for a particular culture.

Theoretical Framework

Persuasive technology is defined by Fogg as any interactive computing system designed to change people's attitudes or behaviors (Fogg 1997). Oinas-Kukkonen and Harjumaa (2009) have devised a model for persuasive system design as a practical instrument for software designer (Oinas-Kukkonen & Harjumaa 2009). This model is currently utilized by business to reach customers all over the globe as the case with Facebook, Twitter, and Google.

Elements of PSD Design

Oinas-Kukkonen and Harjumaa (2009) argue that the quality of a system, based on the non-functional requirements, is what makes it persuasive. Therefore, software designers must first have those quality requirements well-defined. To analyze and communicate those requirements in a systematic way, designers can use all or some of the Persuasive System Design (PSD) principles. The PSD model outlines 28 persuasive design principles, categorized into four groups: Primary Support Task, Dialog Support, System Credibility and Social Support (Oinas-Kukkonen & Harjumaa 2009). In developing and evaluating persuasive systems, designers can use all or some of the principles. The principles are grouped in the corresponding category as follows:

a. **Primary Task Support:** In the primary task support category, design principles aim to substantiate users' primary task and include reduction, tunneling, tailoring, self-monitoring, personalization, simulation and rehearsal (Oinas-Kukkonen & Harjumaa 2009). Reduction is one of the most effective persuasion principles, also accepted in Fogg's models, and is best exemplified by the successful design of Google.com. Implementing principles that help users achieve their goals is the functional aspect of the system (Kegel & Wieringa 2014).

b. **Dialog Support:** An essential area of Human-Computer Interaction (HCI) design is providing user feedback, ideally via symbols or textual information (Shneiderman & Plaisant 2005). Implementing principles in this category allows the user experience to resemble persuasion as in face-to-face human interactions (Oinas-Kukkonen & Harjumaa 2009). For example, the Samsung Health app (Samsung Health, version 5.7.1) is designed as a companion application for a healthy lifestyle, provides encouragement to the user when they attain 50% of their target exercise goal. It also provides, in a simple to read screen, a reward in the form of symbol for achieving the goal.

c. **System Credibility Support:** Persuasive application design should provide users with a feeling of reliability and trustworthiness; for example users should trust that their private information is secure when they are using the application (Studies et al. 1997). Users should also feel as if they are working with a real-world friend (Reeves & Nass 1998). Principles in this category include trustworthiness, expertise, surface credibility, authority, real-world feel, third-party endorsements and verifiability (Oinas-Kukkonen & Harjumaa 2009).

d. **Social Support:** Social environment affects the way users learn and develop habits to interact with an application. This is true with most mobile applications also including gaming and social networking. User behavioral motivation is thus leveraged by social influence (Hamari & Koivisto 2013). Guidelines for social support include the following principles: social facilitation, social learning, social comparison, normative influence, recognition, cooperation and competition (Oinas-Kukkonen & Harjumaa 2009). Individuals are more likely to start using an app when their peers, particularly those who are highly admired within their social circle, are also using the application. WhatsApp illustrates these normative influence and cooperation principles.

The PSD principles are well-structured and serve as a requirement checklist for designers to implement in the persuasive system. However, they do not address users' adoption and loyalty from the user perspective in different cultures. These principles can be more effective if cultural context is considered, since it influences attitudes and reactions to app design, and thus determine the success or failure of business applications.

Cultural effects on the acceptance of Smartphone applications

One of the most popular smartphone applications is instant messaging, an online chat app, attractive for its immediacy and convenience over conventional SMS, email or phone call (Li et al. 2011). Instant messaging also supports VOIP calls, a popular substitute for telephone calls where call charges are comparatively higher than mobile network charges.

Cultural values and norms have influence on instant messaging. Cross-cultural dimensions such as individualism vs. collectivism and high vs. low context do matter in the instant messaging practice (Li 2016). A comparative research of the way Chinese and Dutch use instant messages support this statement (Choi et al. 200). Chinese users have shown preference towards group chat options, implicit communication and easier acceptance for different features on apps. Dutch users have more explicit interactions and less interest in other people's privacy. More interestingly in cases where users are bi-cultural or multi-cultural, they do not fit into predefined categories, which complicate interpretation of results of cultural dimensions (Kim et al. 2005)

Cultural factors also influence functionality design for user interface of mobile data services (Kim et al. 201). Designers adapt attributes such as fonts, colors, minimal keystrokes, icon recognition (Gong et al. 2007), and menu style to users from different cultures and their preferences, as defined in Hofstede's dimensions.

Moreover, socio-demographics represent the strongest indication for predicting the use of smartphone applications (Casalo 2015). Individual user characteristics influence the way people use their smartphone applications. Smartphones appear to be more widely used among people with greater financial wealth and better quality education (Wei 2014).

Finally, cultural differences are visible and measurable, not only in absolutely different cultures, but also in countries with very slight cultural differences. For example, E-loyalty intentions and socio-demographic variables in Argentina and Spain are both moderated by culture (Sánchez-Moya & Cruz-Moya 2015).

Context of the Case: WhatsApp Messenger

This study has chosen the WhatsApp smartphone application to examine PSD principles' impact on users' loyalty. WhatsApp has applied most of PSD principles within the app design which identify it as an ideal candidate for this research with its continually increasing popularity among people from different cultures, age groups and genders (Kasali et al. 2017).

Since the advent of widespread Smartphone adoption, researchers have sought to develop the optimal application design that corresponds to the needs of potential users in different cultures all over the world. Popular apps and games appear to succeed regardless of cultural differences. Examples include WhatsApp, Facebook, YouTube, Twitter (Sawyer 2011), and gaming software such as Half Life, The Sims and Civilization (Hammer & Davidson 2017). WhatsApp has gained worldwide popularity regardless of users' gender, age, educational background and culture. This application is used in 109 countries and most of the adopters are loyal users. Nearly 72% of the WhatsApp users send and receive messages daily, with the platform recording a flow of more than 60 billion messages per day by the end of 2017 (Statista 2018).

WhatsApp works by using the Internet as an alternative to short messaging service (SMS), free at the point of use where the user has access to the Internet. WhatsApp is an effective messaging platform, providing exchange of text and audio messaging, voice calls, photos, videos, documents, PDF files, and user location data. As a micro SNS, it allows users to create their own digital profile, which includes a picture, a nickname and a status (Sánchez-Moya & Cruz-Moya 2015). A recent study on WhatsApp adoption among young people has revealed that undergraduates mostly communicate via text messages (98.10%), photo messages (94.94%), and exchanging information (62.03%) (Ahad & Lim 2014). The global uptake of WhatsApp is considerable: by the third quarter of 2017, 73% of Saudi Arabia's population were using WhatsApp, followed by Malaysia (68%), Germany (65%), Brazil and Mexico (56%), Turkey (50%), and South Africa (49%) in 2017 (Statista 2018). When compared with similar apps like Viber and Telegram, WhatsApp was also the most popular messenger app in 2016 (Sutikno et al. 2016).

As of April 2018, WhatsApp was the leading worldwide mobile messaging app with 1.5 billion users followed by Facebook Messenger with 1.3 billion users, WeChat with 1 billion users, QQ Mobile with 783 million users. Besides these programs, there are other less popular messaging programs such as Skype, Viber, Snapchat, Line, and Telegram, respectively (Statista 2018).

Comparing WhatsApp with Facebook Messenger, researchers have realized that these two platforms do not directly compete. In 2014, perceiving the very large number of global users, Facebook acquired WhatsApp for US$19 billion (Karpisek et al., 2015). Although they have similar messaging features, WhatsApp and Facebook offer different user experiences. Facebook has better support for multitasking and supports self-oriented non-social communications, while WhatsApp, as a messaging tool, is convenient for more intimate and private communication with close friends, family and among micro-communities (Karpisek et al., 2015).

Methodology

Research question and hypotheses

The research question of the study is "What is the impact of PSD principles of apps design on loyalty?" This study has collected and analyzed empirical data on loyalty to WhatsApp from the users' point of view. Four alternative hypotheses have been developed to address the research question. These hypotheses are as follow:

a. Ha: There is a relationship between the dialogue support persuasive system design (DS) and user loyalty. In IT applications, people tend to react as if they are interacting in social situations, hence supporting the dialogue between IT application and the individual user is essential. Dialogue support defines the key principles in keeping the user active and motivated in using the system and is a key factor in behavior change process. System-to-user prompts, praise and reminders play an important role in dialogue support. The dialogue support may be further enhanced by providing users with appropriate counseling and

feedback (Drozd et al. 2012; Hoehle et al. 2015).

b. Hb: There is a relationship between the primary task support persuasive system design (PT) and user loyalty. While computing resources are limited, implementing primary task support techniques is imperative for encouraging sustained use of the application in Smartphone apps (Andrews 2012). This group of techniques allows the user to stay focused on a task until it is successfully completed. For example, the built-in search, and personalized mood indicators image sharing can allow users to connect with their social network directly without having to sign into the full-featured desktop version.

c. Hc: There is a relationship between the social support persuasive system design (SS) and user loyalty. Individuals are more likely to start and continue using an app when their peers, especially the highly admired ones in a social circle, use the same app (Oinas-Kukkonen & Harjumaa 2009).

d. Hd: There is a relationship between the system credibility persuasive system design (SC) and user loyalty. Connection between the credibility of a website and persuasion via the web exists. When a site gains credibility, it also gains the power to change attitudes and even behavior across platforms and devices (Fogg et al. 2002). This connection is more direct than e-commerce in few arenas, where various online claims and promises about products and services provide the primary or sole basis for buying decisions (Fogg & Eckles 2007).

Data Collection

The research used a two-step sampling method for data collection. Sampling error was adjusted by evaluating probability sampling and well-defined target population (Turner 2003). The sample population was designed in order to achieve maximum responses from active Smartphone users (Parreño et al. 2013). Respondents were selected randomly from the online general population in Malaysia, the Netherlands, and Germany, and in college classroom settings in the Kingdom of Saudi Arabia. Invites were sent via a Facebook group in Malaysia, social networks in Germany and the Netherlands. The selection of countries was intended to represent different geo-cultural classifications and a varying cultural spectrum.

Results and Observations

Hypothesis Test Results

Standard multiple regression is used to confirm the hypotheses of this research. Analyses have been done for all subjects, but also individually for each country. Results and conclusions analyzing the effects of PSD elements on user loyalty (SUL) are presented in Table 1. The overall result for all countries explains %37.5 of the variance in the dependent variable, users' loyalty of Smartphone applications. The model for all countries supports three hypotheses, Hb (primary task support), Hc (social support), and Hd (system credibility), while rejecting Ha (the dialogue support). When data populations by countries considered, Ha is only supported by Malaysian sample. Hb is supported by the German and Dutch samples. Hc is supported by German, Dutch, and Saudi samples. Finally, Hd is supported by Malaysia and Germany samples. As the sample from Germany supports three of the four hypotheses (Hb, Hc, Hd), the sample from Saudi Arabia supports only one of the four hypotheses (Hc). Both Malaysian and Dutch samples support two hypotheses.

Table 1: Effects of PSD variables on User Loyalty

Overall	R^2	F	Distance	VIF	Hypotheses inference
PSD-SUL (All)	.375	72.330	M = 19.338 C = 0.077	2.339-4.081	Ha – rejected Hb – supported Hc – supported Hd – supported
PSD-SUL (Net)	.337	22.113	M = 17.474 C = 0.469	1.886-3.194	Ha – rejected Hb – supported Hc – supported Hd – rejected
PSD-SUL (Mal)	.501	22.838	M = 21.452 C = 0.258	3.794-5.104	Ha – supported Hb – rejected Hc – rejected Hd – supported
PSD-SUL (Ger)	.307	13.289	M = 17.116 C = 0.164	1.784-4.091	Ha – rejected Hb – supported Hc – supported Hd – supported
PSD-SUL (KSA)	.466	20.731	M = 15.280 C = 0.288	2.530-4.182	Ha – rejected Hb – rejected Hc – supported Hd – rejected

Comparative analysis of PSD effects on loyalty

The independent (predictor) variable DS has a mean value of 3.59. The independent variable PT has a mean value of 3.79, while SS and SC have mean values of 3.43 and 3.32, respectively across the four sample countries. Figure 1 shows predictor variable means for Dialog Support (DS), Primary Task (PT), Social Support (SS), and System Credibility (SC), separated by country. For all four independent variables, participants in the Malaysian sample show the greatest means compared to the other samples. For SS and SC, participants in the German sample have the lowest means, while Saudi Arabia has the lowest means for DS and PT. It can be concluded in this case that nominally significant differences in the results mark out Malaysia, compared to other countries included in this study.

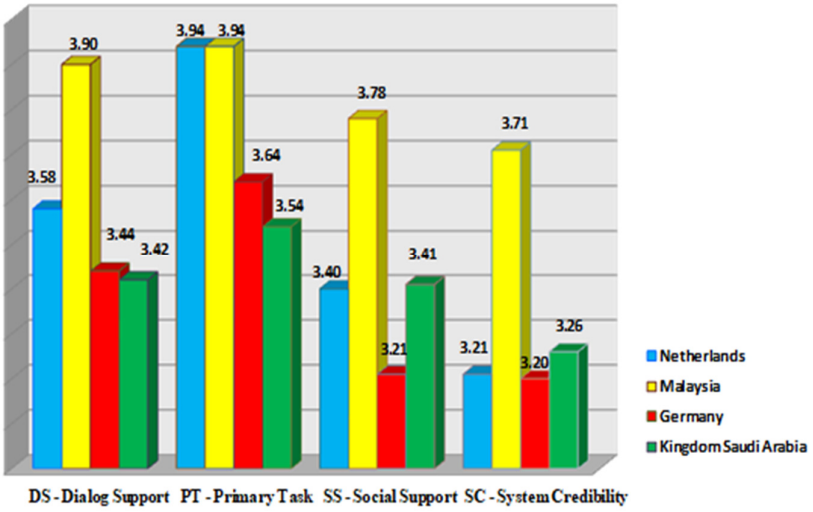

Figure 1: Comparative analysis of PSD variables by sample country

Figure 2 shows the percentages of variance explained by independent variables DS, PT, SS, SC for SUL (Smartphone application users' Loyalty). The highest percentage of variance is explained by the independent variables within the samples from Malaysia (R2= .501) and Saudi Arabia (R2= .466). The lowest percentage of explained variance comes from the Netherlands (R2= 35.3) and Germany (R2= 30.7). Table 1 indicates that the Mahalanobis Distance value for the sample from Malaysia is above the critical value. All VIF values are within the permissible limits, indicating no multicollinearity.

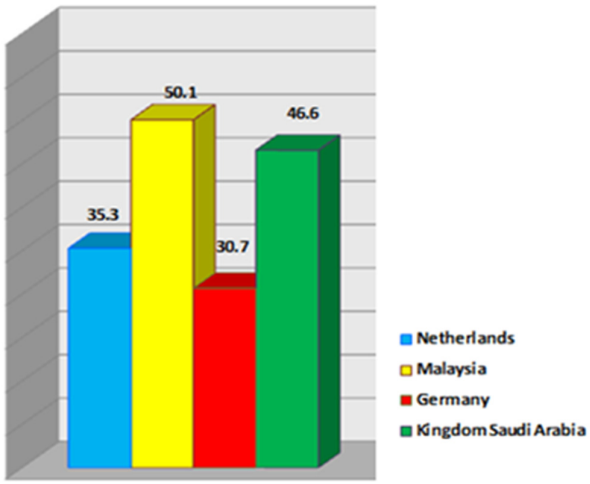

Figure 2: the percent of variance explained by PSD variables

By examining the means of Table 2, we see that respondents from Malaysia have the highest mean score for persuasive system design compared to respondents from the other three countries sampled.

Table 2: Mean scores of PSD Design by Country

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Netherlands	167	3.536	.6002	.0464	3.444	3.627	1.08	5.00
Malaysia	**96**	**3.834**	.9067	.0925	3.651	4.018	1.00	5.00
Germany	125	3.374	.7149	.0639	3.247	3.500	1.27	4.63
K.S.A.	100	3.409	.8297	.0830	3.244	3.573	1.04	4.91
Total	488	3.527	.7621	.0345	3.459	3.595	1.00	5.00

To investigate whether there is a statistically significant difference between the groups in terms of the PSD elements; a one-way ANOVA has been performed using country of residence as the grouping variable and persuasive system design as the dependent variable. As shown in Table 3, there is a statistically significant difference between the mean values of PSD between the four groups. Therefore, it can be concluded that there is an overall statistically significant difference in persuasive system design of respondents dependent on their country of residence. This suggests that although PSD has an impact on loyalty in all countries, this impact varies by the country, possibly affected by the culture. The Post-Hoc Analysis can indicate between which groups this difference exists.

Table 3: Results of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.414	3	4.471	8.032	.000
Within Groups	269.422	484	.557		
Total	282.836	487			

Post-Hoc analyses are important for multivariate hypothesis testing, particularly for negating false positives. A Post-Hoc analysis is used to test hypotheses that are formed after the data are collected, usually when unexpected patterns arise from the data. Tukey's post-hoc test accurately maintains alpha levels at their intended values, provided that statistical model assumptions are met (e.g., normality, homogeneity, independence). The test is commonly used as a tool to identify which pairs of means are statistically different from one another (Granato et al. 2014).

Table 4: Results of Post-Hoc Test Analysis

(I) residence	(J) residence	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 Netherlands	2 Malaysia	**-.29861***	.09556	**.010**	-.5450	-.0523
	3 Germany	.16208	.08824	.257	-.0654	.3896
	4 K.S.A.	.12679	.09434	.535	-.1164	.3700
2 Malaysia	1 Netherlands	**.29861***	.09556	**.010**	.0523	.5450
	3 Germany	**.46068***	.10125	**.000**	.1997	.7217
	4 K.S.A.	**.42540***	.10661	**.000**	.1506	.7002
3 Germany	1 Netherlands	-.16208	.08824	.257	-.3896	.0654
	2 Malaysia	**-.46068***	.10125	**.000**	-.7217	-.1997
	4 K.S.A.	-.03529	.10010	.985	-.2933	.2228
4 K.S.A.	1 Netherlands	-.12679	.09434	.535	-.3700	.1164
	2 Malaysia	**-.42540***	.10661	**.000**	-.7002	-.1506
	3 Germany	.03529	.10010	.985	-.2228	.2933

**The mean difference is significant at the 0.05 level.*

As seen in Table 4, Tukey HSD post hoc test reveals that Persuasive System Design means are significantly greater for respondents from Malaysia (M= 3.83, SD= 0.91) compared to respondents from the Netherlands (M= 3.53, SD= 0.60), Germany (M= 3.37, SD= 0.71) and Saudi Arabia (M= 3.40, SD= 0.76).

This indicates that there is a statistically significant difference in persuasive system design responses between respondents from Malaysia and respondents from all other countries. No other significant difference between the countries has emerged. This result suggests that PSD design has comparatively the most positive impact on loyalty for individuals in Malaysia.

Discussion

The objective of this research is to study the impact of PSD principles on apps design for user loyalty. Results of the study indicate that only respondents in Malaysia have confirmed the dialogue support PSD's effect on loyalty (Ha), as the samples from other countries tend to reject it.

The findings for all the groups are not replicated on a national basis, which is contrary to some of the literature (Lee et al. 2007). The findings indicate that PSD elements vary in their level of impact from one country to another and from one society to another. For example, social support (SS) is more important in the Netherlands than in Malaysia. The theory suggests that the culture and the society in which an individual resides influence their inner life, emotions and worldview, which in turn can be a major factor in their loyalty. Hofstede (2005) argues that loyalty is constructed by individuals' perceptions based on social and cultural factors that are often specific to their place of residence. The Hofstede's Value Survey Module (VSM) scores show that culture is a variable in individuals' perceptions of the world, how we interpret our experiences, and what influences our outlook (Hofstede 2005). This suggests that cultural differences may lead people to construct their reality in different ways. Different societies have different value-systems, conditioning their response to PSD.

While individuals from different countries appear influenced by cultural factors, the effects of globalization should not be ignored (Hassan & Shiu 2017; O'Hara et al.,

2014). People inhabit their national culture, but today there are also 'digital natives' who are engaged with digital experiences, which may be as important to them as their social or real-world interactions (Hassan & Shiu 2017). This suggests that the various elements of PSD are more influential on customer loyalty in some countries than others (Church & de Oliveira 2013). Further, the confirmation of Hb, Hc, and Hd alternative hypotheses for all the countries may also motivate researchers and apps' developers to pay attention to global audiences.

Implications for research and practice

In every country included in this study, it has been found that there is a relationship between PSD design principles and user loyalty. This indicates that PSD is important for motivating user loyalty. Companies whose designs are best fit for a country and their culture can win even further loyalty.

Traditionally, products are designed to fit the needs of a market, to look and feel in ways that suit local tastes and expectations. As a result, the range of designs is diverse and often culturally specific. This has meant high design and development costs and longer response time to reach markets in all targeted cultures for developers.

Globalization is changing how people view their interaction with the world, their outlooks and construction of their values. As a result of the global digital age, individuals redefine themselves as the impact of the global factors that influence their decisions are increasing. This naturally runs counter to the earlier literature (McSweeney 2002; Hofstede 1991). As a result, app design can address groups of people who despite coming from different cultures are part of a global culture.

Conclusion

The literature indicates that "cultures are different" (Hofstede 1991); therefore it is unsurprising that app developers have sought to build solutions for different cultural contexts. However, this study has found that PSD design is a factor affecting user loyalty. The findings also suggest that apps' designers may need to go beyond specific designs for local cultures, towards a global audience. The elements of the PSD that promote loyalty for WhatsApp can differ from country to country, but fundamentally, the design is global and has cross-cultural appeal (e.g. same application interface and colors). Globalization factors are a possible explanation, with the digital age creating the basis for a common global culture. Exposure to the Internet and global ideas can alter individual worldviews and scores on the Hofstede's scale. With the diminishing effect of local cultural dimensions, the design of apps may aspire to be global, as already witnessed in the cases of WhatsApp, Facebook, YouTube and Google, and most gaming applications that have integrated PSD principles in their designs in form of the same interface, design and features for all cultures. Therefore, this study argues that design today should account for PSD elements. However, it also highlights the need to test the local usability component of globalized apps with the help of representative users, as indicated by Al-Qaimari (2005).

The methodology of the research has its own limitations. This research is cross-sectional and considers a single app (WhatsApp). The research sample includes participants from only four countries, which are unlikely to be representative of the global market for apps. The research is therefore not globally representative. For the future research, this study can be expanded globally to include countries with extreme cultural differences within their national society according to the Hofstede's Value Survey Module scores. Further, data have not been categorized into distinct demographic groups, such as age and gender, and social status. Inclusion of these demographic variables may better reveal relationships between different groups in country samples.

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