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ORIGINAL ARTICLE

Predicting Smartphone Operating System from Personality and Individual Differences

AU1 ► Heather Shaw,[1] David A. Ellis,[2] Libby-Rae Kendrick,[1] Fenja Ziegler,[1] and Richard Wiseman[3]

Abstract

Android and iPhone devices account for over 90 percent of all smartphones sold worldwide. Despite being very similar in functionality, current discourse and marketing campaigns suggest that key individual differences exist between users of these two devices; however, this has never been investigated empirically. This is surprising, as smartphones continue to gain momentum across a variety of research disciplines. In this article, we consider if individual differences exist between these two distinct groups. In comparison to Android users, we found that iPhone owners are more likely to be female, younger, and increasingly concerned about their smartphone being viewed as a status object. Key differences in personality were also observed with iPhone users displaying lower levels of Honesty–Humility and higher levels of emotionality. Following this analysis, we were also able to build and test a model that predicted smartphone ownership at above chance level based on these individual differences. In line with extended self-theory, the type of smartphone owned provides some valuable information about its owner. These findings have implications for the increasing use of smartphones within research particularly for those working within *Computational Social Science* and *PsychoInformatics*, where data are typically collected from devices and applications running a single smartphone operating system.

Keywords: smartphones, personality, extended self, brands

Introduction

NEARLY ONE IN TWO ADULTS owns a smartphone and this increases to around two-thirds in developed countries, including the United Kingdom.[1] Many people now spend more than 5 hours a day on these devices, and while data derived from smartphones directly have a great deal to offer researchers, the operating system itself may also provide useful information about the individual behind the screen.[2] Two systems continue to dominate the marketplace, with iPhone and Android smartphones accounting for more than 90 percent of all smartphones sold worldwide.[3] Both engage in extensive but very different advertising campaigns.[4] As a result, considerable discourse surrounds these two operating systems. Current speculation suggests that iPhone users are better educated, more affluent, and are more likely to be addicted to their smartphones than those who choose Android devices.[5] However, no empirical investigation has yet systematically considered the existence or accuracy of these claims. This is surprising because the current 50/50 market split provides an interesting divide, in which to test how existing theoretical constructs that pertain to the self may also help explain how individuals align themselves with a specific smartphone operating system.

Theoretical background

Extended Self-Theory argues that the greater power and control a person exerts over an object, the more they become part of his or her self-identity.[6] In addition to spending long periods of time using these devices, individuals also have a large amount of control over their smartphones, which are highly customizable. Each owner has an almost unique library of downloaded applications, contacts, music, and photographs. This personalization has already allowed for psychological inferences to be made about the end user, and personality traits have previously been inferred from app use and phone usage patterns.[7,8]

Aspects of smartphone use can therefore be considered within the context of an extended self, which has recently been updated to account for changes caused by digital environments.[9] For example, music and videos have become

AU2 ►
[1]School of Psychology, University of Lincoln, Lincoln, United Kingdom.
[2]Department of Psychology, Lancaster University, Lancaster, United Kingdom.
[3]School of Psychology, University of Hertfordshire, Hertfordshire, United Kingdom.

dematerialized as they no longer exist as a physical row of CDs and DVDs, but can now be accessed anywhere in the world digitally via a cloud system. However, the smartphone as an object of hardware still provides a gateway to engaging with and sharing this digital content. Belk's original theory concerning possessions therefore remains highly pertinent when considering smartphones and other new digital devices that may help extend our self and the specific brand of smartphone may act as a marker for several individual characteristics. Other empirical evidence supports the notion that when a person wears an item of clothing, they embody its symbolic meaning.[9] Similarly, people who wear a watch identified themselves as more conscientious than those who do not and exhibited behaviors that were consistent with this personality trait.[10] When applied to smartphone ownership, one might expect that a person will ''embody'' the semantics attached to each smartphone brand.[11]

In this study, we consider how theories of enclothed cognition and the extended self can also be applied to help explain differences between individuals who use Android or iPhone devices.[6,11] Hypotheses concerning specific differences should not be based on the current discourse for the simple fact that these are likely to have been derived from stereotypes, which are often inaccurate when compared to self-report measures.[12,13] Any subsequent hypotheses concerning markers of smartphone ownership should instead be considered in the context of brand personality.[14] Researchers in this domain have focused on how a purchase choice specifically allows an individual to express the self.[6] Specifically, the more congruity that exists between the human characteristics that describes an individual's genuine or perfect self and those that portray a brand, the greater the preference for that brand.[15] This idea has subsequently been developed further into a theoretical framework where multiple personality dimensions can be isolated for each brand. Demographic characteristics such as gender, class, and age are also likely to influence brand preference.[14] Like personality, demographic characteristics may also be inferred from brand imagery or other brand associations. For example, Apple is frequently viewed as young AU3 ► and IBM is considered to be an older alternative.[14]

Hypotheses

While this research aims to understand if the smartphone a person owns provides any valuable information about the user, recent theoretical frameworks concerning brand personality and the effects of brand motivation on subsequent behavior allow for clear hypotheses to be made between those who are likely to use an iPhone or Android smartphone device and we predicted that iPhone users will be will be younger, more extraverted, and open in comparison to those who use Android devices.[16,17] In addition, we also expected that iPhone users would be more likely to place more value in the notion that smartphones should be viewed as high-status objects because Apple as a brand has been increasingly associated with wealth and luxury.[18]

Materials and Methods

Sampling and participants

A total of 728 participants self-selected to take part and 576 individuals completed an online survey giving a final completion rate of 79.12 percent. One hundred eighty-six (32.2 percent) of these were men and 387 (67.1 percent) of these were women, with 3 (0.5 percent) describing themselves as ''other.'' Ages ranged from 15 to 74 with a mean age of 29.05 ($SD = 13.107$). Data concerning current smartphone ownership were also collected. In line with the current market share, 312 (54.1 percent) participants owned an iPhone, 220 (38.1 percent) owned an Android, 22 (3.8 percent) owned a smartphone that ran Windows, 4 (0.6 percent) owned an ''other'' smartphone, 15 (2.6 percent) owned mobile phones that were not smartphones, and 3 (0.5 percent) did not own a mobile phone at all. Overall, the sample comprised 558 (97 percent) smartphone owners and 18 (3 percent) nonsmartphone owners.

For the purposes of our analysis, only individual differences between iPhone and Android smartphone users were analyzed, who made up 92.3 percent of the overall sample. The sample used in this analysis was therefore reduced from 576 to 532 as data were only included from iPhone and Android users. In addition, three participants in this sample self-classified their gender as ''other'' and their data were also removed. This left 529 participants overall.

Procedure

The online survey provider Qualtrics was used to host the *Smartphone Ownership and Personality Survey*, and was accessed via a public link. This was advertised within the University's subject pool, through posters around campus, on several social media sites, inside a local online and print newspaper, and through letters to local organizations. The sample snowballed as this link was shared online. The first page of the survey described its content and purpose. This page also informed participants that they would be entered into a prize draw to win a £50 Amazon voucher. Each respondent was additionally given a random anonymous ID number that they could quote to the researcher if they wished to withdraw their data. Participants were asked if they consented to take part and participant rights were outlined. Those who did not consent were directed straight to a debrief. Throughout the whole survey, a bar appeared along the bottom of each page to show respondents their progress. Demographics such as age, employment status, and gender were collected first. Afterward, participants were asked which smartphone they currently owned. Pictures were shown of Apple iPhones, Android Phones, and Windows Phones to help participants identify their phone. The multiple choice question also included the options ''I don't know,'' ''I don't own a smartphone, but I own a mobile phone,'' and ''I don't own a mobile phone of any type,'' to be inclusive to all phone and none phone owners. The length of time a participant had owned his or her current phone for was also collected. Respondents were then asked to select phones they had owned previously such as ''Blackberry smartphone'' or ''A mobile phone which wasn't a smartphone.''

Materials

Participants completed a series of questionnaires. These included standardized measures of socioeconomic status (SES) and personality via the MacArthur Ladder of Subjective Social Status and the HEXACO-60, respectively (Table 1).[19,20] They ◄T1 were also asked to complete the *Avoidance of Similarity* (*AS*)

Table 1. List of Measures/Variables, Summary Statistics, and Reliability Coefficients Across the Entire Sample ($N = 529$)

Measure	*Number of items*	*Variable*	M	SD	α
Age	1	—	28.74	12.94	—
Socioeconomic status[19]	1	—	5.99	1.52	—
HEXACO-60[20]	10	Honesty–Humility	3.45	0.62	0.75
	10	Emotionality	3.36	0.69	0.82
	10	Extraversion	3.25	0.65	0.80
	10	Agreeableness	3.14	0.61	0.78
	10	Conscientiousness	3.56	0.60	0.79
	10	Openness to experience	3.46	0.62	0.76
Consumers need for uniqueness[21]	4	Avoidance similarity	2.38	0.82	0.88
Attitudes toward mobile phone[22]	6	Phone as status object	2.25	0.59	0.77
Time owned current phone	1	—	12.16	10.02	—

SD, standard deviation.

scale, which was derived from a subscale within a Consumers Need For Uniqueness Scale. This directly taps into brand and product ownership preferences with a high score indicating that participants had a stronger desire to avoid products bought by the majority of the population.[21] Finally, participants completed an *Attitudes Towards the Mobile Phone as a Status Object* (*ATMPSO*) scale.[22]

Results

Direct comparisons

When analyzing gender differences, there was a significant association between gender and the type of smartphone owned [χ^2 (1) = 18.49, $p < 0.001$] with female participants being 2.25 times more likely to own an iPhone than males. To generate scores for the rest of our analysis, average HEXACO, AS, ATMPSO scores were calculated for all participants alongside their raw *SES*, *Age*, and *Time Owned Current Phone (TOCP)* measures. This generated 11 scores per person for our subsequent analysis. Data were then split by the smartphone owned to directly compare the two user groups. Results from a series of independent sample *t* tests are presented in Table 2. In comparison to participants who owned an iPhone, Android users were older and displayed higher levels of *Honesty–Humility*, *Openness*, and *AS*. They also scored significantly lower in *Emotionality*, and felt that a smartphone is less of a *status object*. ◀T2

Predictive modeling

The results of several hierarchical binary logistic regression analyses showed that the variables *Gender* [$\chi^2(1) = 18.36$, $p < 0.001$], *Honesty–Humility* [$\chi^2(1) = 15.63$, $p < 0.001$], *ATMPSO* [$\chi^2(1) = 12.01$, $p < 0.01$], and *AS* [$\chi^2(1) = 5.39$, $p < 0.05$] provided significant χ^2 improvements when added to subsequent models (Table 3). These four variables also had ◀T3 significant beta values across all models in which they were included and were therefore considered to be reliable predictors of smartphone ownership. *Age* did significantly increase the χ^2 value when added to the model [$\chi^2(1) = 14.10$, $p < 0.001$], however, in 7 out of 11 models in which *age* was included, its beta value failed to reach significance. In a similar manner, while *Extroversion* provided several significant beta values in some models, it did not increase χ^2 values significantly and was

Table 2. Descriptive Statistics and Independent Sample *t* Tests Illustrating Differences Between iPhone and Android Smartphone Users ($N = 529$)

	Smartphone					
	iPhone (n = *310*)		*Android* (n = *219*)			
Variable	M	SD	M	SD	t	d
Age	26.85	12.19	31.42	13.52	4.06**	0.33
Socioeconomic status	6.01	1.48	5.94	1.58	0.51	0.04
Honesty–Humility	3.35	0.62	3.59	0.59	4.51**	0.40
Emotionality	3.45	0.66	3.23	0.71	3.69**	0.30
Extraversion	3.28	0.63	3.19	0.68	1.61	0.13
Agreeableness	3.12	0.63	3.17	0.59	0.97	0.08
Conscientiousness	3.57	0.61	3.54	0.59	0.56	0.05
Openness to experience	3.41	0.62	3.54	0.62	2.35*	0.20
Avoidance similarity	2.29	0.81	2.52	0.83	3.26**	0.27
Phone as status object	2.37	0.60	2.08	0.53	5.58**	0.54
Time owned current phone	11.76	8.84	12.72	11.49	1.08	0.04

*Significant at $p < 0.05$.
**Significant at $p < 0.01$ (two-tailed comparisons between iPhone/Android groups).

Table 3. A Series of Binary Logistic Regression Models That Predict Smartphone Ownership ($n = 529$)

	b Smartphone											
Model	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Gender	0.81**	0.77**	0.85**	0.82**	**0.80****	0.79**	0.67**	0.66**	0.64**	0.64**	0.64**	0.64**
Age		–0.03**	–0.02**	–0.02*	**–0.02**	–0.02*	–0.02	–0.01	–0.01	–0.01	–0.01	–0.14
Honesty–Humility			–0.61**	–0.39*	**–0.41***	–0.43*	–0.46**	–0.47**	–0.53**	–0.55**	–0.55**	–0.55**
Phone as status object				0.61**	**0.57****	0.55**	0.51**	0.49*	0.50**	0.50**	0.50**	0.50**
Avoidance similarity					**–0.27***	–0.28*	–0.27*	–0.27*	–0.27*	–0.26*	–0.26*	–0.26*
Extroversion						0.30	0.30*	0.32*	0.31*	0.30*	0.32*	0.32*
Emotionality							0.19	0.19	0.17	0.17	0.16	0.16
Openness to experience								–0.12	–0.14	0.14	–0.14	–0.14
Conscientiousness									0.27	0.27	0.28	0.28
Agreeableness										0.04	0.04	0.04
SES											–0.02	–0.02
TOCP												<0.001
ROC Area	0.59**	0.65**	0.68**	0.70**	**0.71****	0.71**	0.72**	0.71**	0.72**	0.72**	0.72**	0.72**
χ^2 improvement	18.36**	14.10**	15.63**	12.01**	**5.39***	3.39	1.36	0.52	2.65	0.07	0.07	<0.001

The area under each ROC curve was calculated for each model. By adding variables one by one, the increased χ^2 contribution for each variable was also calculated alongside whether this increase was significant. Therefore, model 5 represents an efficient trade-off between accuracy and data efficiency.

Bold denotes the most parsimonious model.

*Significant at $p < 0.05$.

**Significant at $p < 0.01$.

AU8 ▶ ROC; SES, socioeconomic status; TOCP, time owned current phone; *b*, unstandardized regression coefficients.

therefore not considered a reliable predictor [$\chi^2(1) = 4.46$, $p = 0.04$].

The variables *Emotionality*, *Openness to Experience*, *Conscientiousness*, *Agreeableness*, *SES*, and *TOCP* did not add any significant value when predicting smartphone ownership as these variables did not improve χ^2 values. Notably, *Openness to experience*, *Conscientiousness*, *Agreeableness*, *SES*, and *TOCP* did not increase the area under subsequent AU4 ▶ ROC curves (Table 3).

A final analysis tested the accuracy of model 5 (Table 3). A further sample of 221 participants (52.9 percent male), with a mean age of 27.65 ($SD = 11.85$), were asked questions relating to the measures included in this model only. Responses were converted into scores that when summed, corresponded to the beta values of each variable. Dependent on the answer to each question, a value either was subtracted or added to a cumulative score. On completion, an overall positive score predicted that a person would own an iPhone, and a negative score predicted that a person would own an Android smartphone. Participants were provided with this prediction on completion and were then asked to confirm if this was correct. From 200 participants who answered yes or no, the model performed at significantly above chance level (69 percent). This increased to 71.4 percent when participants, who reported that they had previously owned the predicted device, were also included ($n = 210$).

Discussion

In this study, we demonstrate for the first time that an individual's choice of smartphone operating system can provide useful clues when it comes to predicting their personality and demographic characteristics. This confirms that the personalization of a technological experience begins at the point of choosing between the iPhone or Android operating system and as personal devices, smartphones can be considered as an item that extends the self.[6] As predicted, iPhone users were younger and more open in comparison to those who use Android devices. Conversely, Android users consistently appear to demonstrate higher levels of *Honesty–Humility*. Higher levels of *Honesty–Humility* are associated with people who *avoid manipulating others for personal gain*, *feel little temptation to break rules*, *are uninterested in lavish wealth and luxuries*, and *feel no special entitlement to elevated social status*.[23] iPhone users were also more likely to view their smartphone as a status object and less concerned about owning devices favored by the majority of the population.

Interestingly, *Gender* was the strongest predictor concerning smartphone ownership, as women were twice as likely to own iPhones than men. Recent research has demonstrated that men and women use their phones in different ways. For example, women make more phone calls, take more pictures, and send and receive more texts.[24] On the contrary, men use their phones more for entertainment purposes as they play more games and watch more videos.[24]

However, this alone is unlikely to explain why women are more likely to choose an iPhone in comparison to men. While iPhone and Android devices have separate operating systems containing some unique features, the applications and functionality available have become remarkably similar. Future research, however, may wish to specifically consider if people use iPhones and Android phones in unique ways. For example, if the type of applications downloaded (e.g., social and gaming) differs between devices, gender may act as a reliable mediator for subsequent behavior.

While participants' dispositions appear to generally match those promoted by the advertising campaigns for each smartphone user, respectively, *SES* did not vary between the smartphone groups, and therefore, iPhone users did not appear to be more affluent than Android users as previous findings have suggested.[5] It remains difficult, however, to disregard the idea that financial differences do not exist

between smartphone users. For example, the way individuals choose to spend disposable income may still be indicative of smartphone ownership.

These results also raise additional issues as they pertain to psychological research methods. Much research within the field of *Computational Social Science* or *PsychoInformatics* often collects data from smartphone sensors and applications using a single smartphone operating system only.[25–28] However, as individual differences occur between users of different smartphone operating systems, the ''type'' of people who use these devices may have driven findings from previous research. As a result, some conclusions may not generalize beyond that group of smartphone users. Consequently, any research that uses smartphones as a data collection tool in psychology should be aware of these individual differences and aim to collect data using both iPhone and Android smartphone applications where possible.

Limitations and conclusion

Beyond demographic predictors (e.g., age and gender), the use of psychometric over behavioral measures could be viewed as a limitation. However, personality assessments have been shown to portray the core dispositions of a person, which subsequently have been used to predict behavior in many situations.[29] For example, an individual's level of agreeableness has been found to predict the frequency and number of hours he or she will spend playing smartphone games.[30] As a result, we would argue that the current models are informative of how smartphone users will behave in real-life scenarios. A second limitation concerns how we determined ownership. It is possible that some participants in our sample did not choose the smartphone that they currently own. Some participants could have received the smartphone as a gift, and younger participants may have had a parent or guardian purchase the phone on their behalf. Of course, these participants may still ''embody'' the semantics attached with each smartphone brand, but future research would need to consider cause and effect. The decision to own a specific type of smartphone may be driven by some of the traits identified here in the first instance. Alternatively, a purchase may simply be motivated by a desire to become closer to their actual or ideal self by adopting a specific brand.[16]

In conclusion, demographic and personality differences can effectively differentiate Android and iPhone users. Smartphones continue to influence individual and group behavior on a daily basis, and as ubiquitous devices are likely to provide an additional extension of the self.[6,9] While smartphone research continues to gain momentum and becomes ever more complex, it is also important to consider that key information about a person can still be derived from something as simple as an individual's smartphone operating system of choice.

AU5 ► **Author Disclosure Statement**

No competing financial interests exist.

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Address correspondence to: ◀AU7
Dr. David A. Ellis
Department of Psychology
Lancaster University
Bailrigg
Lancaster LA1 4YF
United Kingdom

E-mail: d.a.ellis@lancaster.ac.uk

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