Determining the Factors that Influence College Students' Adoption of Smartphones

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This study examines smartphone adoption behavior among American college students by combining all components of innovation diffusion theory (IDT), the technology acceptance model (TAM), the value-based adoption model (VAM), and the social influence (SI) model. Data indicate that the smartphone adoption rates are beyond the early majority and are now approaching the late majority. The findings of analysis of variance tests revealed that all variables of TAM, VAM, and SI varied across the adopter groups: The current adopter's mean values of the variables were the highest, followed by those of potential and nonadoption groups. Multinomial logistic regression (MLR) analyses revealed that perceived value and affiliation mainly determine the different perceptions of adoption groups. Smartphone adoption, however, was relatively unaffected by perceived ease of use and perceived usefulness. Perceived popularity, perceived price, and ethnicity played a role in distinctive determinants between current adopters and nonadopters. The results imply that adopters perceive smartphones as not only a worthwhile device in which to invest money but also a symbolic device to signal their affiliation and timely technology adoption. Another intriguing finding is the differences of interest in contents between current adopters and nonadopters. Social interactions via social networking services, acquisition for lifestyle, information seeking, and entertainment via gaming were the main applications of interest.

Introduction

In recent years the use of smartphones has become more widespread and continues to grow significantly. Despite the lack of a standard definition, the term *smartphone* generally refers to a mobile phone offering some computer-like functionalities, including Internet access. Because of these advanced functionalities, smartphones have been rapidly replacing traditional cellular phones since 2007, when Apple launched the first iPhone. As of February 2012, 46% of the American adult population owned a smartphone (Pew Internet, 2012). In particular, the smartphone adoption rate of American young adults whose ages range from 18 to 24 is 67%, which is much higher than the average rates for other generations. The rapid penetration rate raises the question of why the growth rate of smartphone adoption has been so high and what features draw people to the new mobile device. Thus, because nearly half of American adults now use a smartphone, a study is needed to examine what factors have accelerated smartphone adoption among college students.

Despite the quick penetration of smartphones into daily use, studies on smartphone adoption are lacking. One reason may lie in the conventional assumption that the smartphone adoption process is not very different from the adoption process of other personal information devices, such as personal digital assistants, the Internet, and mobile phones. This assumption, however, should be reconsidered in the case of smartphone adoption. According to data released by the Nielson Company (2011), women are more likely than men and non-Caucasians are more likely than Caucasians to be included among current smartphone adopters. This finding contradicts the general view of the digital divide that men and Caucasians rather than women and non-Caucasians are more likely to be early technology adopters (Chaudhuri, Flamm, & Horrigan, 2005; Leung &

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Wei, 1999; Lin, 2004; Whaley, 2004). Such contradictions found in smartphone adoption indicate that the smartphone adoption process may be distinctive from that of other antecedent technologies, or it may suggest that smartphone adoption behavior is still determined by traditional adoption factors, but in different ways.

A number of technology adoption studies have employed the technology acceptance model (TAM; Davis, 1989) as a theoretical framework in which the primary components consist of perceived usefulness and ease of use. Despite extensive empirical support for the model's validity, the TAM has not fully explained all aspects of technology adoption. Recent studies have reported that technology adoption could be motivated greatly by factors other than traditional TAM components, such as the adoption's subjectively perceived monetary or nonmonetary costs (Chen & Dubinsky, 2003; Kim, Chan, & Gupta, 2007) or social influence (SI) by others, such as peers or family members (Campbell, 2007; Campbell & Russo, 2003; Kwon & Chon, 2009). These factors are of particular interest to young college students because they are more sensitive to monetary and SI factors when compared with older age groups.

Thus, to examine the smartphone adoption of college students, this study integrates the relevant theoretical approaches of adoption behaviors: innovation diffusion theory (IDT), TAM, the value-based model (VAM), and the SI model. In this regard, the current study focuses on analyzing how each factor associated with IDT and the TAM, VAM, and SI models identifies different smartphone adoption groups (i.e., current adopters, potential adopters, and nonadopters). Then, this study determines how these factors exert a critical role in determining the smartphone adopter groups. The findings of the current study will not only provide a detailed description of college students' smartphone adoption behavior but will also add new findings to the general understanding of technology adoption.

Literature Review

Smartphones and Applications ("Apps")

A smartphone is a mobile phone that offers more advanced computing ability and Internet connectivity than traditional mobile phones. The advanced functionalities of a smartphone enable access to the Internet and the use of various applications as well as phone calling and text messaging. In particular, the advanced mobility of a smartphone can provide users with ubiquitous accessibility to the Internet by transcending the existing limits of time and place so that they help users check e-mail and their accounts on social network services (SNSs) in real time. In addition, the usability of various applications (called "apps" on smartphones), which has been limited on traditional mobile phones, enables smartphones to replace many existing computing devices such as personal computers (PCs) and electronic handheld devices. Such innovative attributes of smartphones may significantly help the diffusion of smartphones become faster than other antecedent technologies (Flurry, 2012).

Innovation Diffusion Theory (IDT)

IDT (Rogers, 1995) has been commonly applied to new technologies and services to predict their adoption. IDT proposes that, within a population group, innovations are not adopted simultaneously by all individuals. Rather, the theory argues that an individual's innovation adoption speed is determined by a wide range of personal (i.e., gender, ethnicity, age, and innovativeness), social (i.e., education and income status), and technological (i.e., perceived usefulness and perceived benefits) factors (Leung & Wei, 1999).

IDT has assumed that some people are more willing to try innovative ideas and technologies than are others. Rogers (1995) argued that sociodemographic factors such as gender, age, education, and income may determine when individuals adopt innovative ideas and technologies. He classified individuals into five adopter categories—innovators, early adopters, early majority, late majority, and laggards—in terms of the time when they actually adopt the innovation (Rogers, 1995). In his subsequent studies, despite some deviations depending on the type of innovation or population, generally the innovators fall in the first 2.5% in the population of adopters, early adopters in the next 13.5%, the early majority in the subsequent 34%, the late majority in the next 34%, and the laggards in the last 15% (Rogers, 1995).

Influenced by Rogers's studies, a large body of literature on innovation diffusion has suggested that personal innovativeness, gender, and ethnicity are predictors of new technology adoption. The more innovative an individual is, the faster the rate of adoption (see Chan-Olmsted & Chang, 2006, for Digital Television; Hung, Ku, & Chang, 2003, for Wireless Application Protocol; Liu, Li, & Carlsson, 2010, for mobile phones). Scholars have also agreed that innovators and early adopters in the United States are likely to be skewed toward young male Caucasians with a high level of education and income status (Chaudhuri et al., 2005; Whaley, 2004, for the Internet; Leung & Wei, 1999; Vishwanath & Goldhaber, 2003, for mobile phones; Lin, 2004, for webcasting).

Although IDT has contributed to our understanding of the profiles of early adopters and late adopters in many hi-tech informational devices that require a high level of knowledge and expertise, it has often failed in identifying the adopters of many personal devices for entertainment and communication such as texting via mobile phones, SNSs, and online games. Recent studies reported different results from the general profile of early adopters that Rogers (1995) had found. For example, Hargittai (2007) reported that among young college students whose ages ranged from 18 through 29, women were more likely than men to be adopters of SNSs such as Facebook and MySpace. She also argued that women use SNSs more often than men because women

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prefer to engage in person-to-person online communication. Given the ability of a smartphone to access SNSs easily and ubiquitously, women's stronger desire to participate in SNSs may lead to different results in smartphone adoption. Such results imply that the adoption decision of innovative ideas and technologies may not be fully determined by the traditional advantages of sociodemographic factors.

Technology Acceptance Model (TAM)

A fundamental assumption underlying the TAM (Davis, 1989) is that the actual technology adoption is influenced by perceived benefits from technology usage. The TAM has provided a major theoretical and methodological framework for investigating technology adoption. Significantly, the TAM takes into account an individual's perception of the use of the technology in question: perceived ease of use and perceived usefulness.

Rogers (1995) defined *usefulness* as the total value that an adopter perceives in adopting a new technology. In the TAM, perceived usefulness refers to outcome expectancy yielded by the consequences of adoption behavior (Venkatesh, 1999). Perceived usefulness is a critical factor in the TAM because this aspect affects an individual's technology adoption. The positive effects of perceived usefulness on mobile technology adoption have been found in many studies. For example, perceived usefulness has been reported as one of the key factors in the adoption intention of mobile Internet (Cheong & Park, 2005; Lu, Yao, & Yu, 2005), mobile data services (Hong, Tam, & Kim, 2006), and mobile banking (Luarn & Lin, 2005).

Perceived ease of use is defined as "the degree to which a person believes that using a particular technology would be free from efforts" (Davis, 1989, p. 320). Not surprisingly, perceived ease of use has long been considered an important factor affecting technology adoption. Perceived ease of use measures the adopter's assessment of ease of use and ease of learning. Park and Chen (2007) reported that perceived ease of use is positively related to the adoption of smartphones, suggesting an indicator regarding smartphone adoption.

Value-Based Adoption Model (VAM)

Despite the wide use of the TAM for technology adoption research, the model is limited in accounting for overall technology adoption behavior because the TAM tends to use only two factors. Thus, there have been some attempts to incorporate other important factors into the TAM (Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003). In addition to the TAM components, this study also includes VAM attributes—perceived price and perceived value—to account for college students' smartphone adoption behavior, with the assumption that perceived price and perceived value may also play critical roles in smartphone adoption due to college students' lower-income status relative to older age groups.

Perceived value is an individual's overall assessment of the utility of a product/service based on the perceptions of what is received and what is given (Zeithaml, 1998). Thus, the perceived value adoption model proposes that an individual's technology adoption is a result of a trade-off between perceived benefits and perceived costs in the use of a technology (Dodds & Monroe, 1985). Perceived costs include not only the actual monetary price of a product but also nonmonetary aspects, such as effort and time. Therefore, the perceived benefits include the perceived usefulness, defined as the total value that an individual perceives from using a new technology (Rogers, 1995). Not surprisingly, high costs tend to prohibit technology adoption and high benefits are likely to be a strong motivation for technology adoption.

Thus far, there have been many attempts to create an extended TAM by adding other components such as personal characteristics, SI, and VAM. For example, Venkatesh and Davis (2000) proposed the TAM2 that incorporates social influence factors—subjective norm, voluntariness, and image—as well as cognitive instrumental factors into the TAM. They found that all factors significantly influenced users' technology acceptance. Likewise, Kim et al. (2007) investigated mobile Internet adoption behavior by combining VAM factors with utilitarian and hedonic factors. They found that both VAM factors directly or indirectly influenced mobile Internet adoption intention.

Social Influence (SI) Model

The SI model is partly based on the subjective norm. *Subjective norm* is defined as "beliefs that certain referents think the person should or should not perform the behavior in question" (Fishbein & Ajzen, 1975, p. 16). In the technology adoption context, subjective norm applies to individuals who are motivated to adopt or not to adopt the technology by observing the adoption behaviors of others with whom they maintain meaningful social relationships, such as family, friends, classmates, and colleagues. In this regard, the SI model posits that individuals' technology perception and adoption are subject to social influence which refers to the impact of individuals' significant referents on the technology adoption decision.

There have also been many attempts to incorporate self-image in the social influence component into the TAM. For example, Venkatesh and Davis (2000) created the construct of positive self-image to account for the role of social influence in technology adoption. Self-image refers to self-expression as a means of boosting status and creating a fashionable display in the affiliated group. The role of self-expression was found to have social influence (SI) model on the adoption of mobile communication technologies (Campbell, 2007; Campbell & Russo, 2003; Lee, Ryu, & Kim, 2010).

Another main component of social influence is perceived popularity, resulting from felt pressure rather than actual needs (Zhu & He, 2002). As individuals observe the adoption behavior of others in neighborhoods and communities,

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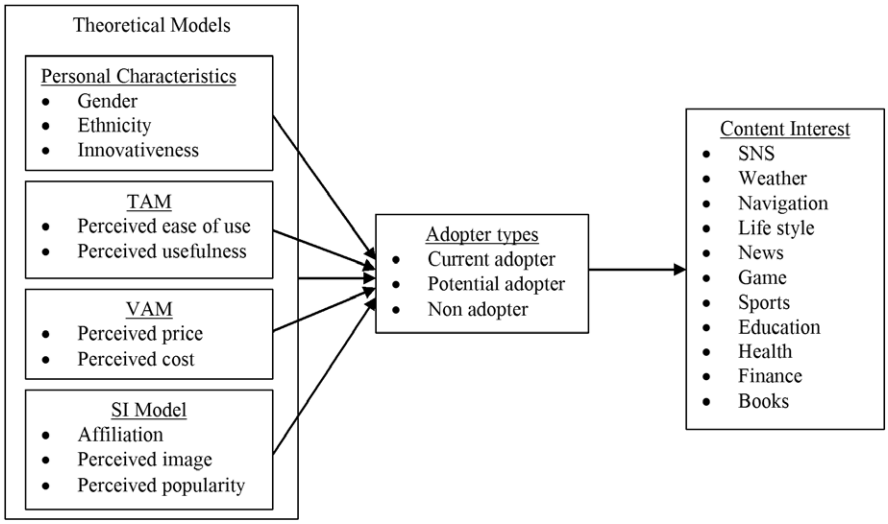

FIG. 1. Conceptual research model.

the potential adopters form a perception of whether a sufficient number of technology adopters exist in a social system. Lou, Luo, and Strong (2000) pointed out that nonadopters may begin to associate the adoption of a technology with popularity through interactions with family members, peer groups, and coworkers and with the entire population (see Hsu & Lu, 2004, for online games; Lou et al., 2000, for groupware technology).

A recent study (Chun, Lee, & Kim, 2012) confirmed the impact of social influence on adopting smartphones. The researchers found that the smartphone adoption behavior of Korean college students is highly influenced by SI factors—affiliation, perceived popularity, and positive self-image—indicating that social influence is as important a factor as technicality.

Content Interest

When compared with traditional mobile phones, smartphones provide users with ubiquitous Internet access and more extended usability of various computer applications. Therefore, smartphone users are able to select and consume a wide variety of content (i.e., communication, entertainment, information, education, and SNSs) without any restrictions of time and place.

This raises an intriguing question: How does content interest differ across smartphone adopter groups? A recent study (Lee, Kim, Seoh, & Lee, 2010) comparing the differences in content interests among Korean smartphone adoption groups reported that current adopters, more than potential and nonadopters, showed significantly higher interest in information, game, education, and weather content. The findings imply that individuals' content interest may also influence smartphone adoption behavior. However, there is still a lack of evidence to explain the relationship between content interest and smartphone adoption.

Research Questions

To examine the smartphone adoption of college students, six research questions are proposed (Figure 1). The first four research questions are posed under the existing theoretical frameworks of the IDT, TAM, VAM, and SI factors, respectively, to examine if each factor could be an indicator used to identify smartphone adopter groups. The fifth research question determines what factors play the most critical role in identifying the smartphone adopter groups when combining all factors into an adoption model. The last research question explores whether content interest could also be an indicator to be included in a future model of technology adoption.

RQ1: Is smartphone adoption behavior of college students affected by personal characteristics (i.e., gender, ethnicity, and personal innovativeness)?

RQ2: Is smartphone adoption behavior of college students affected by TAM factors (i.e., perceived usefulness and perceived ease of use)?

RQ3: Is the smartphone adoption behavior of college students affected by VAM factors (i.e., perceived price and perceived value)?

RQ4: Is smartphone adoption behavior of college students affected by SI factors (i.e., affiliation, positive self-image, and perceived popularity)?

RQ5: How is smartphone adoption behavior of college students predicted by individuals' personal characteristics, TAM, VAM, and SI factors?

RQ6: Do college students' smartphone content interests differ depending on the smartphone adopter groups?

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Methods

Sampling

This study used a web-based, online, anonymous survey. Because it explored college students' smartphone adoption behavior, the survey for this study was conducted at a large university located in western New York from February through April 2011. The respondents were undergraduate students enrolled in an introduction course in communication. They were given an extra course credit as a reward for their participation. In total, 385 samples were collected and 354 final valid samples were obtained. The sample consisted of 48% ($n = 171$) females and 52% ($n = 183$) males. Of the 354 participants, 30% ($n = 105$) were non-Caucasian and 70% ($n = 249$) were Caucasian. The age of the respondents ranged from 18 to 56 years with an average age of 20.27 ($SD = 4.27$). In all, 95% ($n = 338$) of included respondents were 18 to 24 years of age and 5% ($n = 16$) were older than 24 years.

Categorization of Smartphone Adoption Groups

In this study, smartphone adopters were classified into three mutually exclusive adoption categories according to their current ownership of a smartphone: current adopter (respondents have already adopted smartphones), potential adopter (respondents have a plan or intention to adopt smartphones in the next 12 months), and nonadopters (respondents have no intention to adopt smartphones at all within the next 12 months). Among the 354 valid samples, 57.6% ($n = 204$) were current smartphone adopters, 19.8% ($n = 70$) were the potential adopters who were willing to adopt smartphones within the next 12 months, and 22.6% ($n = 80$) were nonadopters who did not have a plan or willingness to adopt smartphones yet. Considering that more than half of American college students currently own smartphones, this study postulated that current adopters in this study may include the first three successive groups of consumers adopting innovations that IDT assumes: innovators, early adopters, and early majority. Meanwhile, potential adopters and nonadopters can be classified into "late majority" and "laggards," respectively.

Measurement

All variables used in this study were measured with multi-item scales (see Appendix). The response format consisted of a 7-point Likert scale, ranging from 1 (*Completely disagree* or *Not at all interesting*) to 7 (*Completely agree* or *Extremely interesting*). Questions for the personal innovativeness were adopted from Chan-Olmsted and Chang's (2006) study. Questions for the perceived usefulness and perceived ease of use were adopted by modifying David's (1989) scales so that questions would specifically reflect the nature of smartphone adoption. Perceived value was measured by means of the scale by Sirdeshmukh, Singh, and Sabol (2002), and perceived price was measured by means of the scale by Voss, Paarasuraman, and Grewal (1998). Questions for social influence factors (i.e., affiliation, positive self-image, and perceived popularity) were mostly from Kwon and Chon's (2009) study. Content interest queried the following 11 content areas that can be commonly accessed from smartphone apps: books, education, sports, games, finance, health, navigation, weather, news, SNS, and lifestyle.

Reliability check tests were conducted to test the internal validity of each of construct. All independent variables achieved acceptable scores above .8 in Cronbach's alpha coefficients, which indicated the reliability of their respective construct (Table 1).

TABLE 1. Number of items and Cronbach's alpha scores of each construct.

Constructs	Number of items	Cronbach's alpha
Personal innovativeness	4	.814
Perceived usefulness	3	.918
Perceived ease of use	3	.900
Perceived price	2	.843
Perceived value	4	.935
Affiliation	6	.908
Positive self-image	3	.881
Perceived popularity	3	.824

Results

RQ1 explores whether smartphone adoption differs on the basis of personal characteristics (i.e., gender, ethnicity, and personal innovativeness). The 171 male respondents consisted of 101 current adopters, 33 potential adopters, and 37 nonadopters. The 183 female respondents consisted of 103 current adopters, 37 potential adopters, and 43 nonadopters. To determine gender differences in smartphone adoption rates, a chi-square test was performed, revealing no significant differences (χ^2 [2, $N = 354$] = .29, p = n.s.).

With regard to ethnicity, 249 Caucasian respondents consisted of of 133 current adopters, 53 potential adopters, and 63 nonadopters, whereas 105 non-Caucasian respondents consisted of 71 current adopters, 17 potential adopters, and 17 nonadopters. A chi-square test revealed a significant difference between Caucasian and non-Caucasian groups in adoption rates (χ^2 [2, $N = 354$] = 6.29, $p < .05$), indicating that non-Caucasians more than Caucasians were more likely to be classified as smartphone adopters. Table 2 presents distribution of gender and ethnicity by adoption.

As presented in Table 3, personal innovativeness scored the highest in the current adopters (mean [M] = 5.46, standard deviation [SD] = .99), followed by the potential adopters ($M = 5.42$, $SD = .83$) and the nonadopters ($M = 5.07$, SD = 1.00). An analysis of variance (ANOVA) test revealed significant differences (F[2,351] = 5.07, $p < .01$, $\eta^2 = .028$), indicating that personal innovativeness is an indicator discriminating smartphone adoption groups. Scheffe post-hoc

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TABLE 2. Distribution of respondents' gender and ethnicity by smartphone adoption group.

	Current adopter ($N = 204$)		Potential adopter ($N = 70$)		Nonadopter ($N = 80$)		Overall ($N = 354$)	
Demographic variable	*f*	%	*f*	%	*f*	%	*f*	%
Gender								
Male	101	59.1	33	19.3	37	21.6	171	48.3
Female	103	56.3	37	20.2	43	23.5	183	51.7
Ethnicity								
Caucasian	133	53.4	53	21.3	63	25.3	249	70.3
Non-Caucasian	71	67.6	17	16.2	17	16.2	105	29.7

TABLE 3. Means and standard deviations of variables and *F* test comparisons of smartphone adoption groups.

	Current adopter	Potential adopter	Nonadopter		
Variable	*M (SD)*	*M (SD)*	*M (SD)*	*F* value	*p* value
Personal characteristics					
Innovativeness ($M = 5.37$, $SD = .97$)	5.46_{ab} (.99)	5.42_{bc} (.83)	5.07_{c} (1.00)	5.07	<.01
TAM					
Perceived usefulness ($M = 5.36$, $SD = 1.28$)	5.80_{a} (1.08)	5.22_{b} (1.07)	4.34_{c} (1.32)	38.89	<.001
Perceived ease of use ($M = 5.68$, , $SD = 1.09$)	5.93_{a} (.98)	5.57_{ab} (1.05)	5.15_{b} (1.19)	5.37	<.05
VAM					
Perceived price ($M = 3.77$, $SD = 1.38$)	4.12_{a} (1.36)	3.52_{ab} (1.31)	3.11_{b} (1.21)	6.55	<.05
Perceived value ($M = 4.94$, $SD = 1.32$)	5.46_{a} (1.18)	4.77_{b} (1.02)	3.77_{c} (1.07)	57.26	<.001
SI					
Affiliation ($M = 4.70$, $SD = 1.19$)	5.01_{a} (1.11)	4.74_{a} (.95)	3.88_{b} (1.21)	19.71	<.001
Positive self-image ($M = 3.99$, $SD = 1.44$)	4.31_{a} (1.41)	3.97_{a} (1.25)	3.18_{b} (1.39)	7.71	<.001
Perceived popularity ($M = 5.26$, $SD = 1.13$)	5.52_{a} (1.02)	5.20_{ab} (1.06)	4.68_{b} (1.23)	6.09	<.001

Note. Means with matching subscripts within the same row are not significantly different from one another. Significant differences are at $p < .05$.

tests also revealed that innovativeness scores of current adopters are significantly higher than those of nonadopters ($p < .05$).

RQ2 explores whether smartphone adoption can be explained by TAM factors (perceived usefulness and perceived ease of use). The average score of the perceived ease of use ($M = 5.68$, $SD = 1.09$) was higher than that of perceived usefulness ($M = 5.36$, $SD = 1.28$). The average scores of both factors were the highest for the current adopters, followed by the potential adopters and nonadopters. ANOVA tests revealed significant differences in the perceived usefulness ($F[2,351] = 38.89$, $p < .001$, $\eta^2 = .181$) and the perceived ease of use (F $[2,351] = 5.37$, $p < .01$, $\eta^2 = .030$) among the adoption groups. Scheffe post-hoc tests revealed that perceived usefulness was significant between all adoption groups, whereas the perceived ease of use was significant only in differentiating the current adopters from nonadopters ($p < .05$).

RQ3 explores whether smartphone adoption is motivated by VAM factors (the perceived price and perceived value). The average score of perceived value was 4.94 ($SD = 1.32$), which was higher than that of perceived price ($M = 3.77$, $SD = 1.38$). As found in the case of other factors, the average scores of both the perceived price and perceived value were the highest for current adopters, followed by potential adopters and nonadopters. ANOVA tests revealed that there were significant differences in the perceived price ($F[2,351] = 6.55, p < .01, \eta^2 = .036$) and the perceived values ($F[2,351] = 57.26, p < .001, \eta^2 = .246$) across three adoption groups. Scheffe post-hoc tests revealed that the perceived price was significant only between the current adopters and nonadopters, whereas the perceived value was found to be significant between all adoption groups ($p < .05$).

RQ4 explores whether smartphone adoption is influenced by SI factors (affiliation, positive self-image, and perceived popularity). The average scores for perceived popularity were the highest ($M = 5.26$, $SD = 1.13$), followed by affiliation ($M = 4.70$, $SD = 1.19$) and positive self-image ($M = 3.99$, $SD = 1.44$). Similar to other factors, the average scores of every SI factor were the highest for current adopters, followed by potential adopters and nonadopters. ANOVA tests also revealed significant differences for all factors ($F[2,351] = 19.77$, $p < .001$, $\eta^2 = .101$ for the affiliation, $F[2,351] = 7.71$, $p < .001$, $\eta^2 = .042$ for the positive self-image, and $F[2,351] = 6.09$, $p < .001$, $\eta^2 = .003$ for the perceived popularity). Scheffe post-hoc tests revealed significant differences between current adopters and nonadopters in the three factors and between potential adopters and nonadopters in the affiliation and positive self-image ($p < .05$).

RQ5 examines what factors are determinants of smartphone adoption between current adopters and nonadopters and between potential adopters and nonadopters. To decide

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TABLE 4. Multinomial logistic regression results predicting smartphone adopter groups.

	Nonadopters vs. current adopter				Nonadopters vs. potential adopters			
Construct	*B*	*SE*	Wald	Odds ratio	*B*	*SE*	Wald	Odds ratio
Personal characteristics								
Gender (1)	.600	.347	2.990	1.822	.291	.370	.618	1.338
Ethnicity (1)	1.059**	.391	7.346	2.883	.415	.429	.935	1.514
Personal innovativeness	–.430*	.219	3.853	.651	.010	.229	.002	1.010
SI								
Affiliation	.474**	.203	5.470	1.606	.500*	.213	5.522	1.649
Positive self-image	.263	.192	1.865	1.301	.290	.204	2.022	1.337
Perceived popularity	.406**	.182	4.956	1.501	.190	.194	.954	1.209
TAM								
Perceived usefulness	.308	.245	1.573	1.360	–.038	.256	.022	.963
Perceived ease of use	.230	.206	1.251	1.259	–.005	.212	.000	.995
VAM								
Perceived price	.431*	.192	5.055	1.539	.081	.202	.159	1.084
Perceived value	1.408***	.282	24.951	4.089	.822**	.287	8.212	2.274
Intercept	3.172**	1.173	7.310		.185	1.250	.022	
Nagelkerke R^2	.394							
Number of cases	354							

Note. Gender (1) = male; ethnicity (1) = non-Caucasian.
*$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 5. Means and standard deviations of variables and *F* test comparisons of smartphone adoption groups.

	Current adopter	Potential adopter	Nonadopter		
Content	*M (SD)*	*M (SD)*	*M (SD)*	*F* value	*p* value
SNS (*M* = 5.86, *SD* = 1.58)	6.08_a (1.27)	5.93_a (1.33)	5.24_b (1.88)	7.82	<.001
Weather (*M* = 5.37, *SD* = 1.41)	5.53_a (1.39)	5.27_{ab} (1.43)	5.02_b (1.40)	2.86	.058
Navigation (*M* = 5.15, *SD* = 1.63)	5.29_a (1.63)	4.76_b (1.67)	5.12_b (1.55)	2.47	.086
Life style (*M* = 4.88, *SD* = 1.66)	5.11_a (1.53)	4.84_{ab} (1.55)	4.31_b (1.90)	5.81	<.01
News (*M* = 4.75, *SD* = 1.63)	4.91_a (1.61)	4.84_{ab} (1.67)	4.24_b (1.58)	6.21	<.01
Game (*M* =4.73, *SD* = 1.86)	5.01_a (1.80)	4.47_{ab} (1.94)	4.21_b (1.83)	6.32	<.01
Sports (*M* = 4.53, *SD* = 2.09)	4.73_a (2.03)	4.39_a (2.19)	4.16_a (2.15)	2.04	.132
Education (*M* = 4.51, *SD* = 1.74)	4.65_a (1.68)	4.37_a (1.77)	4.30_a (1.84)	1.54	.215
Health (*M* = 4.38, *SD* =1.73)	4.54_a (1.67)	4.19_a (1.88)	4.14_a (1.70)	2.01	.135
Finance (*M* = 3.91, *SD* =1.77)	4.05_a (1.78)	3.69_a (1.78)	3.75_a (1.73)	3.19	<.05
Books (*M* = 3.80, *SD* =1.85)	3.82_a (1.77)	3.94_a (1.96)	3.64_a (1.94)	.24	.784

Note. Means with matching subscripts within the same row are not significantly different from one another. Significant differences are at $p < .05$.

the determinants of smartphone adoption groups, this study carried out a multinomial logistic regression (MLR). In the MLR analyses, 10 factors (gender, ethnicity, personal innovativeness, perceived usefulness, perceived ease of use, perceived price, perceived value, affiliation, positive self-image, and perceived popularity) were employed as independent variables, and three adoption groups were employed as the dependent variable (current adopters, potential adopters, and nonadopters). A total of 354 cases were analyzed and the full model was considered to be significantly reliable (χ^2 [20, $N = 354$] = 146.07, $p < .001$). This model accounted for 40% (Nagelkerke $R^2 = .39$) of the variance in smartphone adoption.

As shown in Table 4, it appeared that more factors have a significant impact in the comparison between the nonadopters and the current adopters than in the comparison between the nonadopters and the potential adopters. Although six factors (personal innovativeness, perceived price, perceived value, affiliation, perceived popularity, and ethnicity) had significant impacts in discriminating the nonadopters and the current adopters, only two factors (affiliation and perceived value) had significant impacts in the comparisons between nonadopters and potential adopters. Interestingly, TAM factors (perceived usefulness and perceived ease of use) did not show a significant impact in the pairwise comparisons.

RQ6 examines if respondents' content interest differs by smartphone adoption groups. Table 5 displays the average scores of each content interest and comparison scores by adoption groups. Among the 11 different types of contents available via smartphone, respondents showed relatively higher interest in SNS (*M* = 5.86, *SD* = 1.58), Weather (*M* = 5.37, *SD* = 1.41), and navigation (*M* = 5.15, *SD* = 1.63), when compared with interest in lifestyle (*M* = 4.88, *SD* = 1.66), news (*M* = 4.75, *SD* = 1.63), games (*M* = 4.73,

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$SD = 1.86$), sports ($M = 4.53$, $SD = 2.09$), education ($M = 4.51$, $SD = 1.74$), and health ($M = 4.38$, $SD = 1.73$). Respondents rated the least interest in finance ($M = 3.91$, $SD = 1.77$) and books ($M = 3.80$, $SD = 1.85$).

ANOVA tests revealed significant differences among adoption groups for the content interest in SNS ($F[2,351] = 7.82$, $p < .001$, $\eta^2 = .054$), lifestyle ($F[2,351] = 5.81$, $p < .01$, $\eta^2 = .038$), news ($F[2,351] = 6.21$, $p < .01$, $\eta^2 = .029$), and games ($F[2,351] = 6.32$, $p < .01$, $\eta^2 = .035$). Scheffe post-hoc tests revealed significant differences between current adopters and nonadopters for interest in SNS, weather, lifestyle, news, navigation, and games. Significant differences were found between the potential adopters and nonadopters for SNS ($p < .05$).

Discussion

The primary purpose of the current study was to investigate if college students' smartphone adoption could be explained separately by each factor associated with the existing theoretical models of technology adoption (IDT and TAM, VAM, and SI models) and to determine what factors play a more critical role in smartphone adoption when combining all factors. In addition, this study explored whether individuals' content interests differ depending on their current status in relation to smartphone adoption. The primary finding is that every factor of the models employed in this study is a predictor in identifying smartphone adoption independently. More interestingly, this study found that the factors of VAM and SI more often than TAM appeared to exert a more critical role in identifying adopter groups. Regarding content interest, in some areas of content such as SNS, lifestyle, news, and games, different smartphone adoption groups are found to show significantly different levels of interest.

It should first be noted that based on the *S* curve of the innovation adoption rates (Rogers, 1995), the current adoption rate (58%) reported in this study indicates that smartphone adoption by college students is approaching the late majority stage. The adoption rates are much higher than the U.S. national average smartphone adoption rates (40%) as of May 2011 (Nielsen Company, 2011). Given that the sample of this study consists of young college students, the finding supports the general finding that more rapid technology adoption skews toward younger rather than older adopters.

We found that the personal attributes of smartphone adopters are in part different from those of antecedent technology adoption. Results revealed that smartphone adoption is more likely among non-Caucasians, but no gender differences were found in smartphone adoption. General demographic profiles of early technology adoption are likely to be skewed toward young male Caucasians. Such changes in demographic profiles may mean that the advent and wide use of new technology often influence individuals' communication behavior greatly, which in turn influence decision-making for new technology adoption. For example, by being early smartphone adopters, non-Caucasians, who are less likely to own PCs or laptops, may attempt to enjoy computer-like functions such as an Internet connectivity and online communication. In addition, women's active involvement in communication through social media (Hargittai, 2007) may boost their intent to adopt a smartphone because it offers ubiquitous and immediate access to social media.

Regarding the factors of TAM, VAM, and SI models, there were several notable findings. First, the average scores of TAM factors were much higher than those of other factors. The finding demonstrated that, for college students who are generally computer-savvy, there is little barrier to handling smartphones but high expectations for its usefulness. Second, regarding VAM factors, a large gap was found between the perceived price and perceived value of smartphones. College students in this study thought that owning a smartphone was costly but worthwhile. Last, an interesting finding was that, among SI factors, positive self-image was relatively lower than those of the perceived popularity and affiliation. In other words, college students' smartphone adoption was more motivated by witnessing the wide use of smartphones among their reference groups than by perceiving it as a necessary device to enhance their status in their affiliated groups.

MLR results showed the relative extent to which the respective demographics, TAM, VAM, and SI variables are related. The results showed that the different perceptions of smartphone adopter groups are mainly determined by perceived value and affiliation factors. The smartphone adoption group, however, was relatively unaffected by perceived ease of use and perceived usefulness indicators. Perceived popularity, perceived price, and ethnicity played a role as distinctive determinants only between the current adopters and nonadopters of smartphones.

Above all, affiliation among social influence variables is a main element influencing adoption behavior. Consistent with the results of the adoption-related literature (Bakshy, Karrer, & Adamic, 2009; Hsu & Lu, 2004; Kwon & Onwuegbuzie, 2005; Venkatesh & Davis, 2000), the findings implied that the influence of significant referents, which consisted of the respondents' personal network, is key to explaining the likelihood of adopting a smartphone. The potential and current adopter groups were more likely to be socially pressured into using smartphones if they found that others who they like or think are important have smartphones, or intend to in the near future. However, only the current smartphone adopter group showed a difference from the nonadopter group in terms of the perception of observable popularity. These findings indicated that current smartphone adopters are more susceptible to the perception of critical mass than the other two groups.

Positive self-image, however, did not contribute to the adoption likelihood, indicating that young adults' adoption of smartphones is not associated with enhanced social status and self-expression for the adopter's fashionable display. Kwon and Chon (2009) found the relation between age groups and social influence factors in Digital Multimedia Broadcasting (DMB) adoption in Korea, specifically that the

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older age group tended to perceive affiliation and positive self-image factors more, but the younger age group tended to perceive popularity more. When comparing those findings with the findings of the present study, we conclude that young adults' adoption of smartphones drives them toward affiliation with the adopter's significant others, not toward displaying and enhancing self-image. As a result, the findings reflect the desire to respond to the social forces of smartphone adoption by important referents and, accordingly, the desire not to be excluded from the adopter's group and/or society.

Perceived value was found to be the most important factor determining young adults' adoption decision of smartphones. As with the determinant factors found in prior research (i.e., Lee et al., 2010; Lee, Kim, Ryu, & Lee, 2011), the more valuable and beneficial the respondents felt smartphones to be, the more likely the respondents were to adopt and use them. The current adopter group thought that the cost of a smartphone was reasonable as well. From the perspective of the value-based adoption model, making a decision about smartphone adoption is a trade-off between gaining value and losing money. Eventually, people decide to adopt a smartphone when the value–benefit criteria meet the cost–benefit criteria. Thus, it is reasonable that the current and potential adopter groups evaluated the valuable aspects of smartphones, but only the current adopter group regarded the fee for the trade-off as more normal than the other two groups. Expressed otherwise, the potential adopter group was as motivated by the value and benefit of smartphones as the current adopter group, but was not motivated enough to spend money.

Interestingly, the MLR results showed no effects of perceived usefulness and perceived ease of use on smartphone adoption. Studies that applied the TAM showed seemingly inconsistent results on the effects of perceived ease of use, perceived usefulness, and social influence factors due to cultures, situational contexts, adopter types, and technologies (Lee, Kozar, & Larsen, 2003). It can be inferred from the findings, therefore, that college students are likely to be motivated to adopt smartphones due to social influence rather than the embedded utility-based functions.

Overall, at the early point of the late majority in the rates of smartphone adoption, each adopter group could be characterized in the following ways:

1) Current adopters, comprising 58% of respondents, are more likely than potential adopters to be non-Caucasians and to strongly perceive smartphones as useful and valuable devices to own.
2) Potential adopters, comprising 20% of respondents, who intended to be smartphone adopters within 1 year, have similar perceptions of smartphone to those of current adopters. Like smartphone adopters, they think learning and using a smartphone is easy, that costs to pay for the use of a smartphone are somewhat reasonable, and owning a smartphone is necessary to bolster the status and image within affiliated groups.
3) Nonadopters, comprising the last 20% of respondents, have the characteristics of technology laggards. They lack all dimensions of technology adoption as compared with current adopters. Nonadopters are insensitive to peer-pressure from their affiliations and still feel doubt about the usefulness and overall value of the smartphone.

Regarding content interest, higher interest scores were generally found in the current adopter groups when compared with the other two groups, and higher interest scores are found in the potential adopter groups when compared with the nonadopter group (except in the cases of navigation, finance, and books). In particular, current users of smartphones were highly interested in instant information and communication such as SNS, weather, and navigation. The study indicated that smartphone adoption behavior is highly influenced by informational needs. Additionally, there were significant differences of interest among the adopter groups in SNSs, lifestyle, news, weather, navigation, and games, whereas there was no significant difference of interest in sports, education, books, health, and finance. The findings suggested that despite some exceptions, one's interest in some areas of content could be a predictor of technology adoption that is more related to online content delivery and interpersonal communication, including tablet PCs, mobile television, and mobile game consoles.

Conclusion and Limitations

In conclusion, we suggest that although the adoption rates of smartphones are now beyond the early majority stage, SI and VAM factors more often than TAM factors play a more crucial role differentiating adopter groups among college students. That is, smartphone adopters among college students perceive smartphones as not only a worthwhile device in which to invest money but also a symbolic device to signal their affiliation and timely technology adoption.

Despite several meaningful findings, the study is not without limitations. Above all, the results are limited in terms of generalizability because the samples used in the current study did not cover a wide range of demographics in terms of age, ethnicity, employment, income, and education. Thus, future research is recommended to further investigate determining factors more closely by including extended demographic variables.

Another limitation lies in the fact that this study did not consider market policies in those markets in which most mobile network operators have a presence. Most operators provide their users with an opportunity to switch their old phone for a new smartphone for free or at a huge discounted price when the customers' contract period ends. This may be of particular interest to college students because they have less income than older age groups. Thus, market policies may influence when a person begins using a smartphone. To address these limitations, future research is recommended to examine the impact of market policies on technology adoption to provide a better understanding of technology adoption behavior.

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Appendix (Measurement Indicators)

Personal innovativeness

1. I like to learn about new ideas.
2. I am interested in news stories that deal with new inventions or discoveries.

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3. I like to keep up with new technologies.
4. I am willing to take risks in order to try new things.

Perceived usefulness

1. Using a smartphone is useful in my work/studies.
2. Using a smartphone improves my efficiency.
3. Using a smartphone saves time.

Perceived ease of use

1. Learning to use a smartphone will be easy for me.
2. I will be skillful in using a smartphone.
3. A smartphone is compatible with existing technology.

Perceived price

1. The fee that I have to pay for the use of a smartphone is reasonable.
2. I am pleased with the cost that I have to pay for the use of a smartphone.

Perceived value

1. Compared to the cost of a smartphone, the use of a smartphone offers value for my money.
2. Compared to the efforts I need to put in for the use of a smartphone, the use of a smartphone is beneficial to me.
3. Compared to the time I need to spend on the use of a smartphone, the use of a smartphone is worthwhile to me.
4. Overall, the use of a smartphone delivers me good value.

Affiliation

1. People who I like think one should have a smartphone.
2. People who I like have smartphones or will have one in the near future.
3. Those who are important to me own smartphones already or will have one soon.
4. Those who are important to me think one should own a smartphone.
5. Most people around me (e.g., friends, coworkers) think one should have a smartphone.
6. Most people around me have a smartphone or will have one in near future.

Positive self-image

1. Using a smartphone will allow me to identify myself with the groups that I regard positively.
2. Using a smartphone will enhance my image within my social groups (e.g., school, company, peer group).
3. Using a smartphone will elevate my standing within my social groups.

Perceived popularity

1. In your estimation, how many (by percentage) people in your family are using smartphones?
2. In your estimation, how many (by percentage) of your schoolmates, friends, relatives, and acquaintances are using smartphones?
3. In your estimation, how many (by percentage) of university students are using smartphones?
4. In your estimation, how many (by percentage) of the general population are using smartphones?

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