Validity test of the theory of planned behavior in college students' withdrawal from smartphone dependence

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Abstract

Smartphone usage has brought great convenience to our daily life. However, the detrimental consequences of smartphone dependence also require special attention. Based on the theory of planned behavior (TPB), this study designed a questionnaire to investigate college students' withdrawal from smartphone dependence. The reliability and validity of the questionnaire were tested. The results showed that the reliability of the questionnaire was good ($\alpha = 0.84\text{--}0.94$). The principal component analysis was conducted, contribution rates of these factors were moderately high (62.06%–82.35%). The validity was verified through confirmatory factor analysis. All the model fit indices were higher than the acceptable standard, which indicated the construct validity of the TPB questionnaire is good. The results of the multi-group structural equation model revealed that the model provided excellent fit to the data in each demographic group. The results of structural equation model presented that, in most demographic groups, students' attitude, subjective norm, and perceived behavioral control of withdrawal from smartphone dependence positively influenced their behavioral intention. Furthermore, subjective norm was the most effective predictors in each group. However, part of the paths from intention to behavior failed to reach the significant level, and their coefficients are relatively small. This reveals the gap between college students' withdrawal intention and their actual behavior, and there may be other factors influence the relationship between the two variables.

Keywords College students · Theory of planned behavior · Smartphone dependence · Health promotion

Introduction

Smartphone is an important achievement of modern science and technology, which has significantly changed human behavior and brought a great convenience to people's daily life. Various applications (APPs) together with the development of mobile internet make smartphone a powerful tool that is available almost anytime and anywhere. Because smartphones are Internet-enabled mobile phones, and have multiple functions, a series of tasks and activities such as work, study, entertainment, shopping and social communication can be conducted through this little intelligent devices(Jameel et al. 2019). Therefore, some individuals spend more and more time on smartphones, and gradually, they develop smartphones

dependence. They play with smartphones not only during their work and study, but also before and after sleep, even when walking and driving. Such bad smartphone usage habits have negative impacts on people's physical and mental health. Previous studies have shown that smartphone use increases the risk of brain tumors (Hansson Mild et al. 2007). Using smartphones while walking can put pedestrians at risk of accidental injuries and even death (Nasar and Troyer 2013). There is a significant correlation between problematic smartphone use and depression, anxiety(Demirci et al. 2015) and low self-esteem(Elhai et al. 2017). These symptoms can also cause sleep problems(Demirci et al. 2015). Given the detrimental consequences of smartphone dependence, there is an essential need for individuals to withdraw this bad habit, which will contribute to protecting their physical and mental health.

At present, smartphone dependence is considered as a typical form of behavioral addiction (Arpaci 2019). Studies have demonstrated that positive, negative reinforcement and behavioral habit were important predictors of smartphone dependence (Lee et al. 2014; Turel and Serenko 2012). Positive reinforcement reflects that smartphone use provides positive

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and desirable experience; while negative reinforcement shows that smartphone dependence relieves undesirable feelings (Cheung et al. 2013). The two reinforcements promote the formation and development of smartphone dependence. Habit is an automatic behavior for achieving certain states or goals (Chen et al. 2019), which makes people's decision-making become less goal-oriented and reliant on mindful cognitions (Turel and Serenko 2012). However, the withdrawal of smartphone dependence needs to overcome the influence of positive and negative reinforcements and behavioral habits; this process is conducted under the control of individual's consciousness. Thus, it is reasonable to conclude that behavioral intention is an important prerequisite for the implementation of withdrawing smartphone dependence. Therefore, it is necessary to explore the factors that influence the intentions of college students to quit smartphone dependence, which will provide a good basis for the implementation of this withdrawal behavior.

College students are susceptible to Internet addiction and smartphone addiction (Hawi and Samaha 2016; Kandell 1998). Smartphone dependence – a typical form of Internet addiction – is a salient and serious problem that besets some college students in their study and daily life. In addition to the symptoms mentioned above, many studies have shown that there are significant positive correlations between mobile phone dependence risk and college students' perceived stress and loneliness (Samaha and Hawi 2016; Tan et al. 2013). Although the adverse outcomes of smartphone dependence on physical and mental health have caught the attention of many researchers and participants, participants failed to quit this addictive behavior (Jameel et al. 2019; Yang et al. 2019). As a sample item included in the smartphone addiction scale (SAS) reads: Having tried time and again to shorten my smartphone use time, but failing all the time. Therefore, the relationship between actual behavior and the intention of quitting smartphone dependence needs to be further tested.

TPB is a well-established theoretical framework that is applied to predict people's behavioral intentions and subsequent behavior (Conner et al. 2002). Ajzen believes that a large number of behaviors in daily life are under the control of people's volition, and intention is the immediate antecedent of any behavior (Ajzen and Madden 1986; Ajzen 1985). When individuals intend to act, they can easily perform their behaviors (Ajzen 1985). Based on this, he puts forward the theory of reasoned action (TRA) (Hill et al. 1977). According to TRA, a person's behavioral intention is determined by two major factors: one is the personal factor – attitude, and the other is the social factor – subjective norm. Attitude includes individual's positive or negative assessment of a specific behavior, which is a function of persons' salient beliefs and evaluation of this behavioral consequences; subjective normative factor represents the actor's perceptions of the opinions that whether important persons or groups think he/she should

perform the behavior. However, when he turns to behaviors with incomplete volitional control, he finds that there are some limitations in TRA model. Therefore, Ajzen expands the theory of reasoned action, and adds perceived behavioral control into the original model. Thus, the theory of planned behavior is formed and proposed (Ajzen 1985). Perceived behavioral control has a direct impact on behavior, and it also has an indirect effect on behavior through intention (Madden et al. 1992). At present, TPB has been widely applied to predict various behaviors, such as healthy diets (Shimazaki et al. 2017; Dennison and Shepherd 1995), smoking cessation (Shimazaki et al. 2018), social network use (Pelling and White 2009), violent driving (Parker et al. 1992), etc. The results demonstrate that TPB has wide applicability in diverse contexts. Therefore, in the present study, we adopt TPB to investigate college students' withdrawal from smartphones dependence.

Given the facts that the topic – abstaining from smartphone dependence – has been involved in few studies; individuals' intention to withdraw smartphone dependence may be inconsistent with their actual behavior; and TPB has wide applicability in diverse contexts. Therefore, in the present study, we adopt TPB to investigate college students' withdrawal from smartphones dependence. The aim of this study is to examine the reliability and validity of TPB questionnaire, explore the consistence between withdrawal intention and subsequent behavior, and test the effectiveness of TPB in the research of quitting smartphones dependence.

Methods

Participants

The participants in this study were selected randomly from five universities in Inner Mongolia. The data was collected from April 2019 to June 2019. In total, 1600 questionnaires were sent out, 1521 questionnaires were received, 72 invalid questionnaires were excluded, and finally, 1449 questionnaires from these participants were included in this study. The number of male students was 406, while the number of female students was 1020. Besides, there are 23 participants did not fill in the gender. The age of the participants ranged from 16 to 33 years old (Mean = 21; SD = 2).

Measurements

The questionnaire used in this study was developed based on the guidance manual for TPB questionnaire (Francis et al. 2004). Four dimensions were included: attitude, subjective norm, perceived behavioral control and intention. For each dimension, 4 to 5 items were selected to perform the measurements. The main body of the questionnaire contained 17

questions and measured with a 7-point Likert scale, from “completely disagree” (tagged with 1) to “completely agree” (tagged with 7).

Current engagement in withdrawal of smartphone dependence was measured through the behavior change stages in the transtheoretical model (Prochaska et al. 1994; Shimazaki et al. 2017). Participants were asked to fill in the states of their implementation of (withdrawal behaviors). 1. Participants who did not think they were addicted to smartphones. 2. Participants who did not plan to take the withdrawal behavior were classified into “pre-contemplation” stage. 3. Participants who intended to start the withdrawal behavior within 6 months were incorporated into “contemplation” stage. 4. Participants who intended to engage in this withdrawal behavior within 1 month were included in the “preparation” stage. 5. Participants who had attempted the withdrawal behavior for less than 6 months were considered to be in the “action” stage. 6. Participants who had implemented the withdrawal behavior for more than 6 months were classified into “maintenance” stage.

Although researchers had not yet reached consensus on a formal definition of smartphone dependence at present (Arpaci 2019), it seems that daily smartphone usage time is an important variable to identify this addictive behavior. According to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Association, A. P 2013), the increasing dose of the substance and the growing amount of time spent on these activities were considered as the diagnostic criteria for substance-related disorders and addictive behaviors. Besides, smartphone usage time had been listed as some items or one of the dimensions (such as overuse and tolerance) in many smartphone addiction scales (Bianchi and Phillips 2005; Lin et al. 2014; M. Kwon et al. 2013; Leung 2008; Kim et al. 2014). In fact, some of other symptoms in these scales were caused directly or indirectly by long-term and continuous use of smartphones as well. Moreover, due to the fact that the duration of daily smartphone usage was positively associated with smartphone dependence (Gökçeşlan et al. 2016), therefore, behavior was measured by asking respondents to estimate their average hours of daily smartphone usage, the options given were: less than 1, 1–2, 2–3, 3–4, 4–5, 5–6, and more than 6.

Data Analysis

The missing values of these items in the questionnaire were replaced by the mean values. Cronbach's α coefficient and Spearman-Brown split-half reliability coefficient were utilized to test the reliability of the TPB questionnaire. The validity of the questionnaire was examined by using principal component analysis (PCA) and confirmatory factor analysis (CFA). In order to further verify the construct validity of the questionnaire, a multi-group structural equation model (SEM) was

conducted to measure the effects of demographic variables on the TPB scores. RMSEA, GFI, AGFI, and CFI were used to estimate the fitness of the model during the process of CFA and SEM analysis. The acceptable criteria of the model were RMSEA < 0.1, GFI > 0.9, AGFI > 0.9, CFI > 0.9 (Hopper et al. 2008). SPSS Statistics 22.0 and Amos 24.0 were used for data analysis.

Results

Demographic Characteristics of the Participants

Based on their selections in the behavior change stages, individuals were assigned to two groups. Participants who did not think they were addicted to smartphones were classified into the “No group”, while participants who had engaged in the withdrawal period (from the “pre-intention stage” to the “maintenance stage”) were classified into the “Withdrawal group”. The demographic characteristics of the participants were shown in Table 1.

Reliability Analysis

The Cronbach's α coefficients for the whole questionnaire was 0.95, and that for the four dimensions, “attitude”, “subjective norm”, “perceived behavioral control”, and “intention”

Table 1 Demographic characteristics of the participants

	No group		withdrawal group	
	n	(%)	n	(%)
Gender				
Male	94	23.2	306	75.4
Female	235	23.0	772	75.7
Race				
Ethnic Han	208	21.0	770	77.7
Mongolian	96	26.4	262	72.0
Other minority	17	32.7	35	67.3
Education				
JC student	30	20.5	116	79.5
Undergraduate	273	22.7	909	75.7
Postgraduate	22	28.9	54	71.1
Residence				
City	122	21.9	431	77.2
Town	102	21.9	356	76.6
Countryside	77	24.0	239	74.5
Grazing district	20	31.3	42	65.6

Note: JC student, Junior college student

were: 0.94, 0.84, 0.89 and 0.93 respectively. The split-half reliability of the questionnaire was 0.85.

Validity Testing

The results of PCA were shown in Table 2. Factor loadings of items in the TPB questionnaire ranged from 0.64 to 0.95. And moderate to good (62.06% ~ 85.35%) contribution rates of these factors were yielded by PCA. A CFA was conducted, and the results indicated that the model fitted the data satisfactorily (Fig. 1). The model fit indices were as follows: RMSEA = 0.08, GFI = 0.99, AGFI = 0.96, CFI = 0.99. Therefore, the validity of TPB questionnaire was verified.

As shown in Table 3, Multi-group SEM analysis demonstrated that the model provided an adequate fit to the data, regardless of the demographic characteristics. Table 4 reported the values of the path coefficients and their significance levels. Except several paths, in most demographic groups, attitudes, subjective norm, and perceived behavioral control of the participants predicted their behavioral intentions effectively; and, subjective norm was the most effective predictor across the demographic dimensions (path coefficients = 0.22 ~ 0.46, $p < 0.05$). However, the coefficients of the paths from

intention to actual behavior were relatively small, and half of them did not reach the significance level.

Discussion

Based on TPB model, the present study examined the reliability and validity of the self-designed questionnaire; explored the consistence between withdrawal intention and subsequent behavior; and estimated the effectiveness of TPB in the research of quitting smartphones dependence. The main findings and implications of this study are listed as follows:

The influence of subjective norm on withdrawal intention is consistent and statistically significant across all the demographic variables. Subjective norm refers to a person's perceived social pressure whether or not to perform a certain behavior. Subjective norms are assumed to have two mutual-influenced components: normative beliefs, which refer to the beliefs about how other people, who are important to the actors, would like them to behave; and outcome evaluations, which reflect the positive or negative evaluation of these beliefs (Francis et al. 2004). Combined with the definition of subjective norm, the results of the present study indicate that individuals who are important to college students, such as teachers, classmates, or parents, may consider that it is necessary to quit the bad smartphone use habits, and their opinions are shared by college students.

In the context of gender dimension, all the path coefficients are statistically significant, except the path from males' intention to their behavior. On one hand, this suggests that the relationship between their intentions of withdrawing from smartphone dependence and actual behavior (daily smartphone usage time) may be influenced by other variables. Researchers have found that some variables, such as loneliness (Hong and Hong-Li 2012; An-ming et al. 2018; Wenqing et al. 2018), negative coping style (An-ming et al. 2018), self-esteem and subjective well-being (Lin-ying 2018; Yan et al. 2019), and academic burnout (Qiang and Wei 2019) and so on, are effective predictors of smartphone dependence. On the other hand, in predicting their behavior, the intentions of female students to abstain from smartphone dependence are more effective than males. This may be because, compared with females, males use smartphones more frequently and tend to be more preoccupied with smartphones (Aljomaa et al. 2016). Consequently, under the same conditions, the effect of females' intention to withdraw smartphone dependence on their behavior is more pronounced than males'.

In the context of education, all the path coefficients in junior college and undergraduate level are statistically significant. However, coefficient of the path from graduate students' intention to their behavior does not reach the significant level. One possible explanation for this result is the educational purpose of their smartphone usage. During the survey period, some graduate students told the researchers that although smartphone was also

Table 2 Results of principal component analysis for the TPB questionnaire

Items	Mean	SD	MCLQ	Contribution rate(%)
Attitude				
AT1	5.86	1.62	0.95	85.35
AT2	5.57	1.61	0.93	
AT3	5.81	1.56	0.91	
AT4	5.79	1.55	0.90	
Subjective norm				
SN1	5.53	1.65	0.83	62.06
SN2	5.68	1.59	0.83	
SN3	5.12	1.69	0.82	
SN4	4.21	1.86	0.81	
SN5	5.10	1.64	0.64	
Perceived behavioral control				
PBC1	4.99	1.71	0.92	75.52
PBC2	4.43	1.82	0.89	
PBC3	4.84	1.67	0.86	
PBC4	5.25	1.65	0.81	
Intention				
IN1	5.52	1.53	0.92	82.19
IN2	5.42	1.63	0.91	
IN3	5.03	1.70	0.90	
IN4	5.24	1.65	0.89	

Note: MCLQ, main component load quantity

Fig. 1 Results of confirmatory factor analysis Note: PBC, perceived behavior control, **: $p < 0.01$.

utilized for playing games and social networks communications by most of the people, this intelligent device had become one of the essential tools for their studies. As academic research has been an important work in postgraduate stage, it is necessary for graduate students to consult materials and share experiences with classmates and tutors during their studies. Compared with computers and paper-based learning materials, smartphones are not only easy to carry but also offer internet access almost anywhere and anytime (Gerpott and Thomas 2014). Therefore, they use smartphones to interact with teachers outside classes, manage their group assignments, and access learning materials or some supporting information, which are normally accessible through the Internet (Anshari et al. 2017). Consequently, the intention to withdraw smartphone dependence does not show a significant negative correlation with the time they actually spent on their smartphone.

In the ethnic dimension, other minorities do not show statistical significance in two path coefficients: attitude to intention and intention to behavior. However, it can be observed that the correlation directions of the corresponding coefficients are consistent with Han and Mongolian. This indicates that the intention (to abstain smartphone dependence) of minorities' participants also has the desired impact on their behavior, nevertheless, this influence may be moderated or weakened under the action of other factors. Usually, college students use smartphones for two main purposes: online gaming and social interactions, while in minority students, the meaning of this behavior is more abundant. For example, smartphone usage provides various learning resources and careers guidance; builds a new communication platform, which can improve minority students' abilities to

understand and adapt different ethnic culture (Dan and Yi 2016); The acculturation function of smartphones and other modern media can also help minority students to establish a "modern" identity (Xun 2016). Therefore, in order to communicate with others in different regions, learn from various cultures, send and retrieve interesting information, minority students may spend more time on smartphones than other people, thus, non-significant path coefficients are yielded.

In the residential dimension, the intention of participants from the countryside cannot predict their behavior at a significant level ($P < 0.05$); the corresponding path coefficient of participants from the grazing district is positive, but the value is very small. This may be associated with the special economic and cultural conditions in the two areas. Compared with cities, the infrastructures in the countryside and grazing areas are still relatively backward, especially in Inner Mongolia. Therefore, smartphones and the internet are important ways for people in these areas to obtain various information and meet their spiritual needs. By using smartphones, residents in the rural and pastoral areas can acquire information resources, expand their horizons, enrich their knowledge and experiences, and improve their humanistic and cultural literacy; these functions are of great significance for the enhancement of people's self-efficacy, cultural identity and psychological satisfaction (Jun-Qi and Zhang 2019). Research shows that internet use improves the happiness index of the rural residents (Zhongkun and Chenxin 2018; Jun-Qi and Zhang 2019), especially that of young people (Jun-Qi and Zhang 2019). Thus, college students who originally come from the countryside and grazing district may have stronger demand for information, and the path coefficient of their intention to the withdrawal behavior may not reach the significant level or the correlation direction may be inconsistent.

The intention of cities' participants cannot significantly predict their behavior. One possible explanation is that people who live in urban area tend to have a large demand for information. With the pace of life increases continually in city, there are a growing number of tasks need to be tackled. Thus, lots of information is required. Moreover, due to the fact that only by constantly acquiring and processing information through

Table 3 Results of multi-group SEM

Group	RMSEA	GFI	AGFI	CFI
Gender	0.06	0.99	0.96	0.99
Race	0.05	0.99	0.95	0.99
Education	0.04	0.99	0.96	0.99
Residence	0.04	0.99	0.95	0.99

Table 4 Path coefficients based on demographic characteristics

	AT → IN	SN → IN	PBC → IN	IN → behavior
Gender				
Male	0.20**	0.46**	0.24**	−0.06
Female	0.31**	0.36**	0.28**	−0.11**
Education				
Junior college student	0.40**	0.31**	0.29**	−0.18*
Undergraduate	0.25**	0.43**	0.26**	−0.08**
Postgraduate	0.53**	0.22*	0.18*	0.03
Race				
Ethnic Han	0.27**	0.38**	0.29**	−0.09**
Mongolian	0.32**	0.40**	0.19**	−0.12*
Other minority	0.16	0.47**	0.32**	−0.04
Residence				
City	0.34**	0.32**	0.29**	−0.06
Town	0.23**	0.46**	0.25**	−0.18**
Countryside	0.22**	0.45**	0.22**	−0.08
Grazing district	0.37**	0.44**	0.10	0.01

Note: AT: attitude; SN: subjective norm; PBC: perceived behavioral control; IN: intention * $p < 0.05$; ** $p < 0.01$

smartphones can people conduct their social activities and various tasks anytime and anywhere. Therefore, it is possible that the fundamental requirements of daily life account for most of the smartphone usage time. Compared with this, the real effects of smartphone dependence on usage time will not be very obvious. Under this circumstance, withdrawal behavior of urban participants cannot be significantly predicted by their intention.

According to TPB, generally, the immediate and only determinant of a behavior is the intention to perform it (Ajzen 1985). However, whether the behavior plan can be executed depends not only on the effort invested but also on person's control over other factors (such as technology, skills, abilities and necessary information, and so on) (Ajzen 1985). The results of this study suggest that in some demographic characteristics (such as male, postgraduate, city, countryside and grazing district, etc.) intention cannot significantly predict behavior, which reveals that there exists the “intention-behavior gap” in the process of withdrawal smartphones dependence. “Intention-behavior gap” refers to the phenomenon that despite people have good behavioral intentions; they often failed to implement it. In fact, “intention-behavior gap” has been found in a number of empirical studies, such as ethical consumption (Carrington et al. 2014), physical activity and dietary behavior (Hall et al. 2008; Godin and Conner 2008), electronic waste recycling (Echegaray and Hansstein 2017), knowledge sharing practices (Kuo and Young 2008), and on-line courses (Henderikx et al. 2017), etc. Previous studies have demonstrated the main factors that can influence people to translate their intention into action, these factors include the dimensions of behavioral goals, the basis and properties of the intention (Sheeran and Webb 2016). As far as smartphone

dependence is concerned, this addicted behavior is affected by many variables, such as sensation seeking (Chan 2017), behavioral habit (Turel and Serenko 2012), positive and negative reinforcement (Chen et al. 2019), and fundamental information requirement (M. S. Kwon and Lee 2017; Panova and Carbonell 2018), etc. Therefore, in order to have a better understanding of smartphone dependence, and make a reasonable explanation for the intention-behavior gap, we need to consider the influence of various factors comprehensively.

From what has been discussed above, when TPB is applied to predict college students' withdrawal from smartphone dependence, attention should be paid to the following problems. On the one hand, in different demographic characteristics, there may be diverse factors that affect the actual behavior of the participants; thus, when researchers attempt to predict the withdrawal behavior of the participants, the influence of their living contexts and that of their special information requirements need to be considered. On the other hand, it can be seen from the results of data analysis that whether or not they are statistically significant, all of the values of the coefficients for the paths between intention and behavior are small, thus, future research should consider the causes of the intention-behavior gap. In fact, although empirical studies show that smartphones dependence has brought detrimental consequences on physical and psychological health of college students, it is acknowledged that smartphone has been an indispensable tool and has penetrated deeply into individuals' daily life. Therefore, the necessary time spent using smartphones for the purposes of study and work increases as well. How to clarify the boundary between dependency and the necessary use is a problem that needs to be considered in future research.

Conclusions

In this study, the Theory of Planned Behavior (TPB) was used to predict college students' withdrawal from smartphone dependence. The reliability and validity of the TPB questionnaire were tested; the consistence between withdrawal intention and subsequent behavior was examined, and the effectiveness of TPB in the research of quitting smartphones dependence was also investigated. The results show that the reliability and validity of the self-designed TPB questionnaire are good; and TPB model can fit the data well; however, there exists a gap between the intention and the actual behavior. In summary, although there are some problems that have not been fully explained and demonstrated, the present study still provides useful information to understand college students' withdrawal from smartphone dependence, and new ideas and methods for relevant researches on this topic. Future research should explore the variables that bridge the intention-behavior gap and test the factors that affect the withdrawal behavior of the students, especially in some demographic characteristics such as male, graduate, other minority, city, countryside and grazing district.

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Compliance with Ethical Standards

Conflict of Interest There is no conflict of interest.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Approval Statement and Informed Consent This study had got the approval and the informed consent from the College of Psychology Inner Mongolia Normal University.

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