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Clarifying the Impact of Social Escapism on Users' Smartphone Addiction Based on Technology Acceptance Model

Hsiu-Ju Chen [a*]

[a] *I-Shou University, Taiwan.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

In the recent decades, smartphone addiction has been addressed its importance in daily life. With smartphones, people can use the Internet even more easily. People can also use smartphones at any time in any place. Nevertheless, the psychological causal variables for smartphone addiction are still not clear. Furthermore, people with low self-esteem are shown to reveal more personal information online for social compensation. It is also unclear what causes the social compensation. This study is therefore motivated to clarify users' smartphone addiction based on the technology acceptance model (TAM). Survey method was adopted. Data of one hundred and seventy-one valid respondents who used smartphones were gathered online. Factor analysis and regression analysis were adopted for data analysis using SPSS 18.0. The regression path analysis results indicate that perceived escapism, increased by perceived enjoyment, significantly associates with users' smartphone addiction. The results also show users' different smartphone addiction patterns under different perceived usefulness of smartphones. The results facilitate users' self-management of smartphone use via increasing perceived usefulness and the cure of smartphone addiction.

Keywords: Smartphone addiction; technology acceptance model; perceived usefulness; perceived enjoyment; perceived social escapism.

**Corresponding author: Email: hjchen@isu.edu.tw;*

1. INTRODUCTION

Smartphones have growing importance in modern life. With the growth of diverse apps, smartphones provide different functions for users via the Internet. For instance, people can play Internet games via apps on smartphones. People can also interact with friends or strangers via social apps, such as Instagram, WhatsApp, or Facebook. People can see cartoon, movies, TV show series, etc. and surf the Internet and at any time in any place with smartphones, too. Consequently, users spend more time on smartphones [1], but the time can be non-productive and wasteful.

In the recent decades, smartphone addiction has been addressed its importance in daily life [2]. Smartphone addiction is linked to mental health problems and distracted driving. There are more than one in three people across the globe who own a smartphone [3]. The time people spend on smartphones is also increasing [4]. Yet, the causal variables for smartphone addiction are still not clear. It's significant to notice the issue. Furthermore, people with low self-esteem are shown to reveal more personal information and express more of their personal facets online [5]. However, it is unclear whether the social compensation is due to enhancing popularity or feeling more comfortable being themselves online [5]. This study is therefore also motivated to clarify the issue.

TAM provides a simple but fundamental model to describe users' use of technology [6]. The simplified TAM model removes the constructs of attitude and intention, and indicates important variables that causes user' use of information technology [7]. Perceived ease of use and perceived usefulness are two important constructs in technology acceptance model (TAM) [6]. Fauzi et al. [8] validates the impact of perceived enjoyment on young adolescents' smartphone addiction. Perceived ease of use increases perceived enjoyment [9,7]. And perceived enjoyment increases perceived usefulness [7]. This study is, therefore, motivated to clarify users' smartphone addiction based on the model.

Furthermore, according the flow perspective, one of the two kinds of motivation directs toward long-term goals and is work orientation (Wong and Csikszentmihalyi, 1991). This study, therefore, also clarifies the smartphone addiction patterns under different perceived usefulness, which reflects the instrumental value of smartphones.

2. LITERATURE BACKGROUND

2.1 Smartphone Addiction

In 2021, mobile traffic accounts for 56 percent of all internet traffic, compared to only 6 percent in 2011 [1]. 80% of social media browsing is composed by smartphone usage [1]. For example, 95.1 percent Facebook users use smartphones to access the functions [1]. 86 percent Twitter usage is from mobile devices [1]. And 60 percent LinkedIn usage is on mobile devices [1]. As a result, smartphone addiction gradually becomes a social issue.

Generally speaking, many users are not interested in a single app in particular, but they find it hard to resist apps that are easily accessible [4]. The average time which people spend using the mobile internet for American adults is around 3 hours and 30 minutes per day in 2019. It increases up to 20 minutes per day as compared to 2018 [10].

Internet addiction has been an important social issue today. For example, students who have Internet addiction are reported to have 2.5 times higher risk of depression than those who do not have [11]. A school-based survey of 14–17-year-old adolescents conducted in seven European countries shows that the dysfunctional Internet behavior is significantly higher among boys than among girls and varied widely between countries [12]. Social media is interactive, but can be also non-productive. People commonly address that they feel time waste on social media, but that the medium is addictive [13]. However, social interactions messages and "likes" on social media can cause the release of dopamine. They produce the same chemical involved in drug addiction [14]. This helps people to relieve. People use smartphone to access the Internet and social media easily and mobile. This makes smartphone addiction an even more difficult problem.

With the increasing importance of smartphone addiction, this study is therefore motivated to explore the causal relationship of adult users' smartphone addiction. The results facilitate users' self-management of smartphone use and the cure of smartphone addiction.

2.2 Technology Acceptance Model

Technology acceptance model (TAM) is a behavioral model developed by Davis et al. [6] to understand users' use acceptance of information technology based on the theory of reasoning action. Davis et al. [6] intend to find an effective model in explaining users' acceptance of computer technology and analyzes variables for users' acceptance. The model provides a basis to understand the interrelationships between beliefs, attitude, intention and use of information technology.

The TAM model is effective to explain or predict users' use of information technology. Perceived usefulness and perceived ease of use are two core variables that enhance users' attitude. And attitude contributes to use intention, which leads to use [6]. In addition, perceived ease of use determines perceived usefulness [15, 6].

However, about TAM, many advanced researches focus on use behavior directly, which removes the construct of attitude and use intention. For example, Huang and Liao [16] clarify the impact of users' perceived usefulness on sustainable relationship behavior. Chen and Lu [7] validate the impact of perceived escapism on users' use of online KTV.

The simplified TAM model is also further extended. For instance, in the World-Wide-Web (WWW) environment, Moon and Kim [9] indicate that the two beliefs are not sufficient to explain users' behavior toward information technology. They, therefore, introduce perceived playfulness as a new factor to reflect the user's intrinsic belief in WWW acceptance. Based on the study of Moon and Kim [9], Chen and Lu [7] further extend the model with the impact of perceived social escapism in users' acceptance of online entertainment service. The study indicates that perceived enjoyment, a sub construct of perceived playfulness, enhances users' perceived social escapism, which increases usage in TAM. These studies not only simplify the TAM model but extend different motivations for use behavior.

The simplified extended TAM model predicts use behavior, and still provides the robustness. In addition, among the studies, the model of Chen and Lu [7] provides the psychological basis of perceived social escapism in the TAM model. Smartphone users can easily use Internet for diverse functions via mobile broadband. To explore users' smartphone addiction, this study is, therefore, based on the model

In addition, internet use cane be related to smartphone addiction because of resources availability [2]. Smartphones are also easily available to users [2]. This study is therefore also motivated to clarify both the impact of average daily Internet use time and average daily smartphone use time on smartphone addiction.

2.3 Perceived Social Escapism

Escapism refers to seek distraction and relief mentally from unpleasant or boring life. It indicates the avoidance of the boring or difficult 'realities of life by focusing on the pleasant, imaginative or the easy' [17, 13, 18, 19]. It is adopted to occupy one's self away from persistent general feelings of sadness or depression and involves entertainment [17-19,13]. The situation is especially serious for people to move themselves into the digital world and escape from the rigors of daily life [20].

Virtual reality provides a form of escapism [19]. Video games and virtual worlds increasingly provide the ability to make people feel like escaping the real world, like entering into meta world. For example, people may play mobile games for entertainment to escape from boring reality in life on smartphones. People may also interact with others for complimenting friends on social media on smartphones to escape from boring life routines. In spite that social media is more interactive than passive entertainment, the interaction is often non-productive (Artemis et al., 2014).

Kothari [2] figures out causes that contribute to smartphone addiction, including loneliness, stress, unstable home environment or work environment, anxiety in social situations, and availability of resources. About loneliness, smartphones with social media apps facilitate people to communicate more with others and feel less lonely. Regarding stress, smartphones can help relieve stress temporarily by watching movies or reading e-books, etc. Concerning unstable home environment or work environment, smartphones facilitate people to escape from daily challenges or pressure. With regards to anxiety in social situations, smartphones provide a way to connect with people easily but avoid nerves. Finally, about availability of resources, smartphones provide internet connectivity for maximum use of the resources at any time in any

place. Consequently, smartphones become an important tool of resources which helps people to escape from loneliness, stress or anxiety.

Virtual world provides a way of escapism [19,5]. Perceived social escapism not only provide the ability to make people escape the real world, but meets users' needs for social compensation [7]. Perceived social escapism can thus be an important motivation that people use smartphones too much. This study is, therefore, motivated to clarify the impact of perceived social escapism on users' smartphone addiction.

3. RESEARCH HYPOTHESES

The relationships among perceived ease of use, perceived usefulness, perceived enjoyment and smartphone addiction.

Perceived ease of use and perceived usefulness are two important core constructs in clarifying users' technology acceptance behavior in the TAM model [15, 7, 6, 21]. They are believed to be fundamental in determining the acceptance and use of information technology [9]. Perceived usefulness is also increased by perceived ease of use because users believe that when computer technology use is easier, people can finish more jobs based on the same effort [6].

In the World-Wide-Web (WWW) environment, Moon and Kim [9] introduce perceived playfulness to reflect user's intrinsic belief in WWW acceptance in compensating the insufficiencies of the two beliefs to explain users' behavior toward information technology. Perceived enjoyment, a subconstruct of perceived playfulness, also reflects users' flow state of joy [6]. It is not only affected by perceived ease of use, but affects use behavior.

Fauzi et al. [8] clarify the perceived enjoyment on young adolescents' smartphone addiction. However, the impact of perceived ease of use on perceived enjoyment and the impact of perceived enjoyment on perceived usefulness are not validated [9,6]. This study is therefore motivated to clarify users' smartphone addiction based on TAM.

Therefore, based on the literature, the following hypotheses are proposed.

H1. Perceived ease of use increases perceived usefulness.
H2. Perceived ease of use increases perceived enjoyment.
H3. Perceived enjoyment increases perceived usefulness.
H4. Perceived ease of use motivates users' smartphone addiction.
H5. Perceived usefulness motivates users' smartphone addiction.
H6. Perceived enjoyment motivates users' smartphone addiction.

3.1 The Impact of Perceived Social Escapism

In addition to task-oriented and intrinsic fun-oriented factors, Chen and Lu [6] propose that when users enter into the state of flow of enjoyment, the continuous flow of interaction with information technology drives them to escape from the real world without time-consciousness. Furthermore, it is unclear whether social compensation online is due to enhancing popularity or feeling comfortable being oneself online [5]. Perceived enjoyment reflects the flow state and drives users' social escape from loneliness, boredom, and anxiety. The social escape can attract users' entering into the digital world to escape from the real world [22] and thus increases smartphone addiction. Therefore, based on the literature, the following hypotheses are proposed.

H7. Perceived enjoyment increases perceived social escapism.
H8. Perceived social escapism motivates users' smartphone addiction.

3.2 The Impact of Income and Average Daily Smartphone use Time

Finally, availability of resources is indicated important drive of users' smartphone addiction [2]. Money and smartphones are both easily available to users [1]. This study is therefore motivated to clarify both the impact of income and average daily smartphone use time on users' smartphone addiction. The hypotheses are thus proposed.

H9. Income motivates users' smartphone addiction.
H10. Average daily smartphone use time motivates users' smartphone addiction.

The hypotheses are provided in Fig. 1.

Furthermore, based on the flow perspective, one of the two kinds of motivation directs toward long-term goals and is work orientation (Wong and Csikszentmihalyi, 1991). Perceived

usefulness reflects the instrumental value of smartphones. This study, therefore, also motivated to clarify the smartphone addiction patterns under different perceived usefulness.

H11. Users perceiving different perceived usefulness of smartphones present different addiction patterns.

4. RESEARCH METHODOLOGY

All constructs definitions and measures of the study are based on existing literature and instruments. Items in the questionnaire are measured on a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree.

4.1 Perceived Ease of use and Perceived Usefulness

The measures of perceived ease of use and perceived usefulness in traditional TAM studies are adopted. Perceived ease of use is a unidimensional construct which measures smartphone use easiness [6]. It includes easiness to learn to use, easiness of operation, easiness to use to meet needs, and overall ease of use [23]. Perceived usefulness is also a unidimensional construct which measures smartphone usefulness [6]. It refers to subjective belief that smartphone use will increase personal performance. Items contains making better performance, improving life routine convenience, improving efficiency, making enjoy life, and overall usefulness [23].

4.2 Perceived Enjoyment

The measure of perceived enjoyment of smartphone use is included in the study. Five question items measuring perceived enjoyment contain being pleasant, being a happy process, entertaining, fun, and being overall joyful [24, 25].

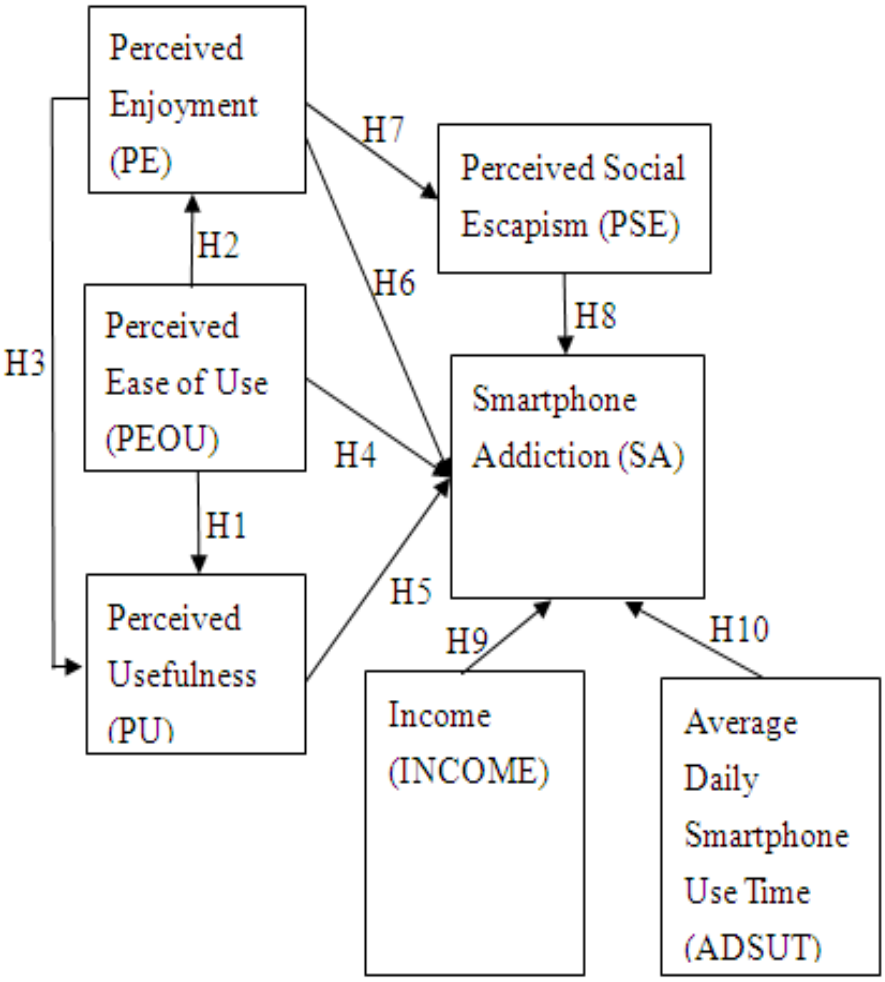

Fig. 1. The research model of the study

4.3 Perceived Social Escapism

Perceived social escapism refers to escaping from the real world via smartphone use [26]. Items measuring perceived social escapism include forgetting the reality, not feeling lonely, temporarily forgetting annoying things, helping relaxing, and attracting and leading emotions and feelings [6,26].

4.4 Income and Average Daily Smartphone use Time

Income is measured on a Likert's five-point scale, including less NT$10,000, between NT$10,001 and NT$30,000, between NT$30,001 and NT50,000, between NT$50,001 and NT$70,000, and above NT$70,000. Average daily smartphone use time is also measured on the Likert's five-point scale, including less than one hour, 1-3 hours, 3-5 hours, 5-7 hours, and more than 7 hours.

4.5 Smartphone Addiction

Smartphone addiction refers to smartphone addiction disorder [27,28]. The items measuring smartphone addiction is adapted based on the studies of Chen et al.[27], Cheng [29], and Kwon et al. [28]. The question items are shown in Appendix A.

4.6 Data Collection

An online questionnaire survey is adopted in data collection in September, 2020 by the author. The online questionnaire address is either transferred to users via Line (a social app on smartphones) or emailed to users. In responding, users are first asked if they agree to answer the questionnaire. The respondents who disagree to answer are dropped. Users who are older than twenty years old and have already used smartphones are surveyed. There were one hundred and eighty respondents. By excluding data response with missing value, finally, after five months, there are one hundred and seventy-one valid respondents. The demographics of the respondents are shown in Table 1.

5. DATA ANALYSIS AND THE ANALYSIS RESULTS

With the limit of sample size, factor analysis is first done using SPSS 18.0. After the factor analysis, regression analysis is analyzed to understand the path impacts also using SPSS 18.0.

5.1 Factor Analysis of Constructs

Factor analysis for constructs is done. The Kaiser-Meyer-Olkin (KMO) value, Bartltett's sphericity test, and extracted square of factor loadings are provided. First, the KMO value of perceived ease of use is 0.85 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 89.13%. Second, the KMO value of perceived usefulness is 0.85 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 80.61%. Thirdly, the KMO value of perceived enjoyment is 0.87 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 87.43%. Fourthly, the KMO value of perceived social escapism is 0.81 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 71.43%. Fifthly, KMO value of use is 0.83 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 88.69%. Finally, the KMO value of smartphone addiction is 0.93 and Bartltett's test is significant ($p<0.001$). The extracted square of factor loadings is 65.25%. The factor loadings of each construct are summarized in Table 2. The reliabilities of all constructs are also provided in Table 2.

The results in Table 2 indicate good construct convergent validity and reliabilities, and show adequate factor loadings. Overall speaking, the results suggest good measurement properties.

5.2 Regression Analysis

With good reliabilities and adequate construct factor loadings, regression analyses are then done to verify the impacts. However, to verify the validity of the construct relationships, the analysis results of traditional use construct as dependent variable are first provided. The F value of the regression analysis of perceived usefulness is 189.45 ($p<0.001$). The F value of regression analysis of perceived enjoyment is 234.07 ($p<0.001$). The F value of regression analysis of perceived social escapism is 45.74 ($p<0.001$). Finally, the F value of regression analysis for smartphone addiction is 16.37 ($p<0.001$). The standardized coefficients and the adjusted R-square values are all summarized in Fig. 2.

Table 1. The description of the respondents

Items	Frequency	Percentage	Items	Frequency	Percentage
Occupation			Gender		
Students	99	57.9%	Male	107	62.6%
Governmental and Military Service	53	30.9%	Female	64	37.4%
Service Industry	7	4.1%	Education		
Manufacturing industry	3	1.8%	High School	27	15.8%
Financial Industry	3	1.8%	College	15	8.8%
Information Industry	2	1.2%	University	112	65.5%
Others	4	2.3%	Graduate School	17	9.9%
Income					
Below NT$10,000	80	46.8%	Age (years old)		
NT$10,01-30,000	27	15.8%	20-25	113	66.0%
NT$30,001-50,000	36	21%	26-30	24	14.0%
NT$50,001-70,000	19	11.1%	31-35	4	2.3%
Above $70,000	9	5.3%	36-40	2	1.2%
Average daily smartphone use time			41-46	10	5.9%
Below 1 hour	7	4.1%	46-50	10	5.9%
1-3 hours	28	16.4%	51-55	2	1.2%
3-5 hours	56	32.7%	56-60	4	2.3%
5-7 hours	46	26.9%	Above 60	2	1.2%
Above 7 hours	34	19.9%	Total	171	100.0%

Table 2. The summarized factor loadings of constructs

Construct	AVE	CR	Cronbach's α	PEOU	PU	PE	PSE	SA
Perceived Ease of Use (PEOU)								
PEOU1	0.89	0.97	0.96	0.94				
PEOU2				0.96				
PEOU3				0.92				
PEOU4				0.96				
Perceived Usefulness (PU)								
PU1	0.81	0.95	0.94		0.84			
PU2					0.89			
PU3					0.93			
PU4					0.92			
PU5					0.91			
Perceived Enjoyment (PE)								
PE1	0.87	0.97	0.96			0.92		
PE2						0.92		
PE3						0.92		
PE4						0.96		
PE5						0.95		
Perceived Social Escapism (PSE)								
PSE1	0.72	0.93	0.90				0.80	
PSE2							0.87	
PSE3							0.90	
PSE4							0.83	
PSE5							0.83	
Smartphone Addiction (SA)								
SA1	0.65	0.97	0.97					0.61
SA2								0.61
SA3								0.79
SA4								0.65

Construct	AVE	CR	Cronbach's α	PEOU	PU	PE	PSE	SA
SA5								0.81
SA6								0.85
SA7								0.70
SA8								0.88
SA9								0.84
SA10								0.88
SA11								0.79
SA12								0.82
SA13								0.86
SA14								0.85
SA15								0.85
SA16								0.87
SA17								0.83
SA18								0.85
SA19								0.85
SA20								0.86

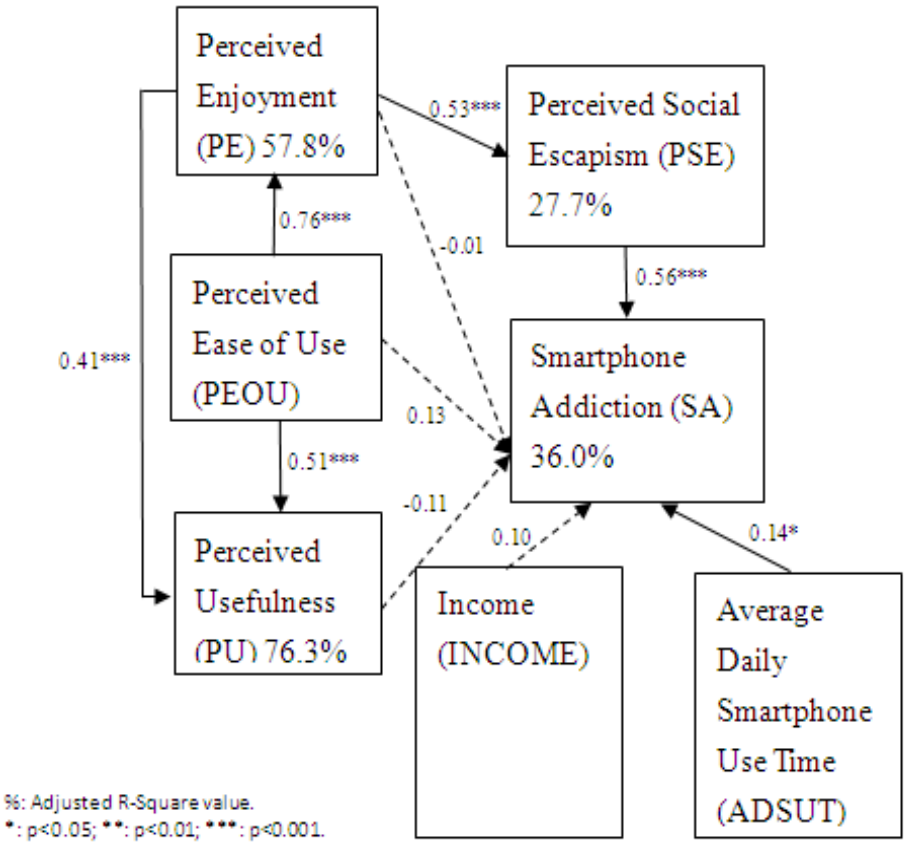

Fig. 2. The summarized regression analyses for smartphone addiction

For perceived usefulness of smartphones, perceived ease of use and perceived enjoyment are significantly associated with perceived usefulness. Therefore, the hypotheses of H1 and H3 are supported and not rejected.

For perceived enjoyment of smartphones, perceived ease of use is significantly associated with perceived enjoyment. Therefore, the hypothesis of H2 is supported and not rejected.

For perceived social escapism of smartphones, perceived enjoyment is significantly associated with perceived social escapism. Therefore, the hypothesis of H7 is supported and not rejected.

Finally, for smartphone addiction, perceived ease of use, perceived usefulness, perceived enjoyment, average daily Internet use time, and average daily smartphone use time are not found significantly associated with smartphone addiction; only perceived social escapism has significantly association with smartphone addiction. Therefore, the hypotheses of H4, H5, H6 and H9 are not supported but rejected. Only the hypotheses of H8 and H10 are supported.

To further understand users' different smartphone addiction patterns under different perceived usefulness of smartphones, the addiction results are shown in Fig. 3 and Fig. 4.

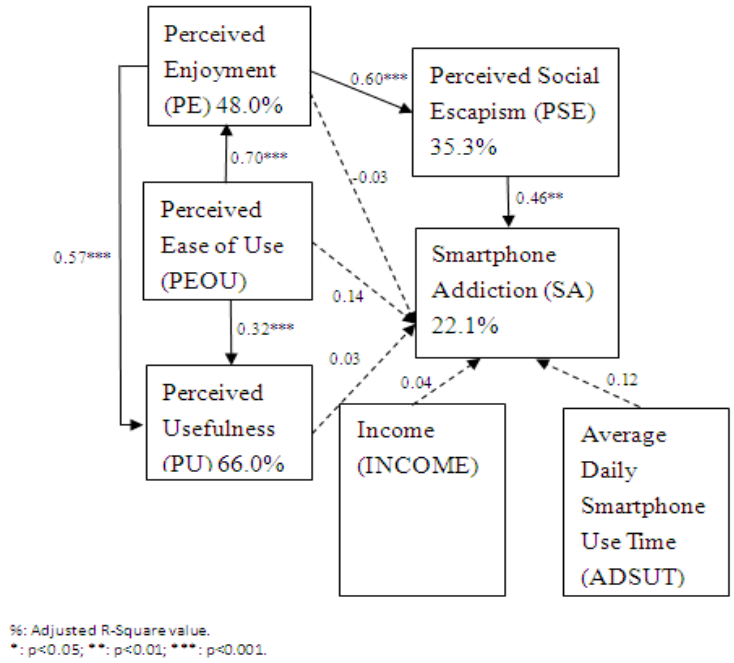

Fig. 3. The summarized regression analyses for smartphone addiction of low perceived usefulness

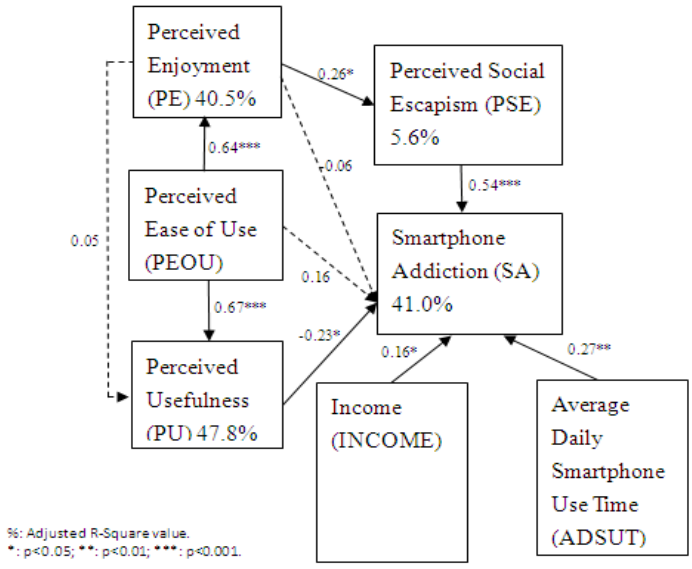

Fig. 4. The summarized regression analyses for smartphone addiction of high perceived usefulness

In Fig. 3, the results of users who perceive low usefulness of smartphones show that only perceived social escapism significantly increases smartphone addiction. The adjusted R-square value is 22.1%.

However, in Fig. 4, the results of users who perceive high usefulness of smartphones show that not only perceived social escapism significantly increases smartphone addiction, but income and average daily smartphone use time also significantly increase smartphone addiction. Nevertheless, perceived usefulness significantly decreases smartphone addiction. The adjusted R-square value is 41.0%. Furthermore, perceived enjoyment does not significantly increase perceived usefulness. Its impact on perceived social escapism is also low.

The results in Fig. 3 and Fig. 4 show that users present different patterns of smartphone addiction patterns when they perceive different instrumental value of smartphones.

6. DISCUSSION

Most studies measure users' smartphone addition [30, 31, 32, 33, 28, 34, 35]. Nevertheless, limited studies explore the psychological causal relationship affecting users' smartphone addition. It is also unclear whether the social compensation is due to enhancing popularity or feeling more comfortable being oneself online [5]. Based on the extended TAM model, this study makes an empirical study of users' smartphone addition. The results indicate that only the factor of perceived social escapism causes users' smartphone addition.

6.1 The Impact of Perceived Social Escapism and Perceived Enjoyment

The results show that for smartphone addition, perceived social escapism is significantly associated with users' smartphone addition. And perceived social escapism is significantly motivated by perceived enjoyment. However, perceived enjoyment is not significantly associated with users' smartphone addition. The results indicate that perceived enjoyment impacts perceived social escapism which influences smartphone addiction, but perceived enjoyment does not directly impact smartphone addiction [8].

The results validate the psychological causal relationship affecting users' smartphone addition. The social compensation is due to feeling more comfortable being oneself online, rather than enhancing popularity [5]. The results correspond to the studies of Chen and Lu [6], Huang and Liao [16], and Kothari [2].

6.2 The Impact of Perceived Ease of use and Perceived Usefulness

In addition, perceived ease of use significantly enhances perceived enjoyment, which increases perceived social escapism. Perceived usefulness is also significantly enhanced by perceived ease of use and perceived enjoyment. Nevertheless, perceived ease of use and perceived usefulness do not significantly motivate smartphone addiction. The results reveal that escapism indicates the avoidance of the boring or difficult realities of life by focusing on the pleasant and the ease. Users' smartphone addiction is not task-oriented [6].

6.3 The Impact of Income and Average Daily Smartphone use Time

The results show that average daily smartphone use time is significantly associated with smartphone addiction. However, income is not shown of significant impact on smartphone addiction. The results indicate that the time spent on smartphones matters to users; the resource of people' income does not.

6.4 The Smartphone Addiction Patterns of users Perceiving Different Instrumental Value of Smartphones

The results show that users present different patterns when they perceive different usefulness of smartphones. When users perceive high instrumental value of smartphones, the results show higher adjusted R-square value. Perceived social escapism, income and average daily smartphone use time all significantly increase smartphone addiction. However, perceived usefulness significantly decreases smartphone addiction. Users present conflicting psychology regarding smartphone addiction.

In addition, when users perceive low instrumental value of smartphones, the results show lower adjusted R-square value. Only perceived social escapism significantly increases smartphone addiction. Perceived enjoyment does not increase perceived usefulness, either. The results indicate that users present different smartphone addiction patterns when they perceive different instrumental value of smartphones.

7. CONCLUSION

TAM explains and predicts users' information technology use. Via internal beliefs of users, information technology use can be affected. In smartphone addiction, perceived enjoyment help users' social escapism, which causes the smartphone addiction. The results reflect that smartphone addiction is not simply intrinsic fun-oriented. People get enjoyment via ease of use and enter the virtual world to escape the difficult and unpleasant reality. This provides a psychological basis for smartphone addiction. In addition, the time spent on smartphones matters; the income of people does not matter for smartphone addiction.

To further understand users' smartphone addiction under different use motivations, users are grouped based on the average of perceived usefulness of smartphones (Wong and Csikszentmihalyi, 1991). The results show different smartphone addiction patterns when users perceive different instrumental value of smartphones. The results correspond to the flow perspective (Csikszentmihalyi, 2000)[7] and show users' different allocation in the flow state. Perceived usefulness significantly decreases smartphone addiction; users do not get addictive to tools. However, resources of income and the daily time to use smartphones significantly increased users' smartphone addiction. The conflicting psychological basis can be provided to facilitate users' self-management of smartphone use and the cure of smartphone addiction.

8. LIMITATION AND SUGGESTIONS

However, users' smartphone addiction exploration cannot be established on a single empirical study. Further studies that validate the model under different cultural contexts or different personal use contexts are encouraged. Finally, exploring the factors that affect users' social escapism is also suggested.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Author has declared that no competing interests exist.

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Appendix A. Smartphone Addiction

SA1. I find that my smartphone use time exceeds my planned time.
SA2. I set aside executing things and spend time using smartphones.
SA3. I feel excited about smartphone messages far more than any other interpersonal interactions.
SA4. I make new friends via smartphone.
SA5. I am complained or blamed by family because of smartphone use.
SA6. I leave early or am late for school/work due to smartphone use.
SA7. I check Facebook or Line on smartphones every few hours.
SA8. I perform not well at work or fall behind at school due to smartphone use.
SA9. I defense or hide the content I use smartphone when someone asks.
SA10. I use smartphone to seek support or social comfort.
SA11. I can't wait to use my smartphone after I wake up.
SA12. Without smartphone use, I feel that life is meaningless.
SA13. If someone disturbs me in my smartphone use or suggests me to decrease smartphone use frequency, I feel angry.
SA14. I shorten sleeping time due to smartphone use.
SA15. I think constantly of smartphone content when off use.
SA16. When I use smartphone, I repeatedly lengthen the use time.
SA17. I try to shorten smartphone use time or not to use smartphone, but have a failure experience
SA18. I try to hide my smartphone use time or use content.
SA19. I choose to spend time in using smartphone, not in going out.
SA20. I am in a low mood when I do not use smartphone all the day.

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