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Research Article

Standardization of Smartphone-Related Pictures for Cognitive Bias Tasks of Smartphone Addiction

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Abstract

This study aimed to develop a set of standardized smartphone-related pictures and investigate the possible rating biases for smartphone-related cues among college students with smartphone addiction. College students with (N=18) and without (N=23) smartphone addiction rated four kinds (pictures of apps, pictures of using smartphone, pictures of smartphone brands and pictures of smartphone) of smartphone-related pictures (N=96) on four dimensions: pleasantness, attractiveness, familiarity and craving, and the rating biases for smartphone-related pictures were tested. The results demonstrated significant rating differences on smartphone-related pictures between college students with and without smartphone addiction. Participants' rating scores in four dimensions were significantly correlated. The overall result of the study is a database of 96 smartphone-related pictures that could be used to validate an implicit measure of cognitive biases for smartphone in college students with smartphone addiction.

Keywords: Smartphone addiction; Standardization; Rating difference; College students

Introduction

According to eMarketer [1], the number of smartphone users all over the world was estimated to be near 2.16 billion in 2016. More and more people tended to choose smartphone and become increasingly reliant on it. With increasing accessibility of wireless network and smartphone, problematic behaviors related to smartphone usage are becoming a serious issue worldwide. Studies [2-6] suggested that smartphone over usage may have negative effects on human beings' life in many ways. For example, Lee, Lee [2] found that overuse of smartphones caused a deficiency of sleep and attention in youth. According to Oulasvirta, Rattenbury [3], frequent repetitive habitual use of smartphone could be induced by easy access to dynamic content of smartphone and it would be probably perceived as an annoyance. Adverse psychological and physiological outcomes also emerged when iPhone users were separated from their iPhone [4]. To make matters worse, the overuse of smartphone would lead to smartphone addiction which linked to a variety of maladaptive outcomes, including physical health challenges, academic failures, and emotional and behavioral problems [5-7].

A number of studies explored the characteristics of smartphone addiction. For example, van Deursen, Bolle [5] distinguished addictive smartphone behaviors from substance addictions and indicated that smartphone addiction is a kind of behavioral addiction, which excessive and compulsive smartphone use and a preoccupation with and loss of control over this use that interferes with individuals' daily functioning. Su, Pan [8] proposed that smartphone addiction is a new behavioral addiction with new dimensions such as frequent App use and update which is different from internet addiction. Emanuel, Bell [9] revealed the truth of smartphone addiction was that people were addicted to contents smartphone could convey (i.e. information, entertainment, personal connections), not smartphone itself. Jeong, Kim [10] indicated that the smartphone use purpose played an important role in smartphone addiction, smartphone addiction could be positively predicted by specific usage, such as SNS use, games use, and entertainment use, rather than study-related use. Different scales were developed to measure smartphone addiction which included the core features of smartphone, such as daily life disturbance, compulsive behavior, withdrawal and tolerance, cyberspace-oriented relationship, feeling anxious and lost and so on [9,11-17]. Ahn, Wijaya [18] analyzed the smartphone users' using diaries through App to figure out the features of smartphone addicts, finding that smartphone addicts varied from non-smartphone addicts in the preference of applications and the time of addicts spent on smartphone is much longer than that of non-addicts. Possible factors of smartphone addiction were also investigated. Jeong and Lee [19] advocated that empathy level of nursing students should be assessed to guide their proper use of smartphone since empathy was an important influencing factor for their smartphone addiction. Lower level of self-control and higher level of stress would lead to higher possibility of smartphone addiction among elementary school students [10]. Depression, aggression, and impulsion were also found to positively related to smartphone addiction [15]. Choi Kim [20] found the risk factors (i.e. female gender, Internet use, alcohol use, and anxiety) and protective factors (depression and temperance) of smartphone addiction among college students in South Korea. Even though these studies investigated some psychological variables about smartphone addiction, most of them have concentrated on the descriptions of smartphone addiction or related problems, few studies have examined the cognitive figures of smartphone addicts.

In the light of the incentive sensitization theory of addiction [21], addicts have attention biases and pathological motivations toward addiction-related cues, such as words, pictures and movies, which were sensitized or hyper-sensitized [22]. Numerous studies have

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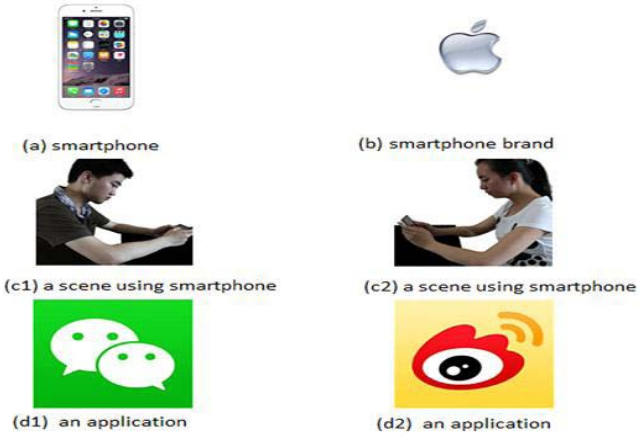

Figure 1: Samples of pictures used in picture rating.

proved these biases. Brignell, Griffiths [23] found that individuals with pathological eating behaviors showed attentional and approach biases for pictorial food cues; Luijten, Veltman [24] indicated that smokers had attentional bias toward smoking cues; cognitive biases toward alcohol beverage pictures were found in individuals with mild to borderline intellectual disability and alcohol use problems [22,25]. Nonetheless, studies on smartphone addicts' cognitive biases were limited, Investigating these cognitive biases would be helpful to understand why the smartphone is so attractive and provide implications for future intervention [26,27], while the standardized materials in related studies were also limited. Thus, the present study aimed to develop a set of standardized smartphone-related pictures, which could be utilized in exploring cognitive biases of college students with smartphone addiction. Since familiarity would influence cognitive processing [28], pleasantness, attractiveness and craving were involved with reward psychologically and functionally [29], four dimensions (pleasantness, attractiveness, familiarity and craving) of addiction-related pictures were adopted in our study [22,23,28,29]. Based on previous research [3,5,22], college students with smartphone addiction were expected to rate differently to smartphone-related pictures compared to college students without smartphone addiction, they might rate smartphone-related pictures as more pleasant, more attractive, more familiar and more craving.

Methods

Participants

A total of 41 college students were recruited to rate pictures and divided into two groups according to their scores on Smartphone Addiction Scale for College Students (SAS-C) [8]. 18 of them (SACS, 14 females, 4 males) were addicts with an average age of 19.83 (SD=1.1) years, 23 of them (NSACS, 20 females, 3 males) were non-addicts with an average age of 20.03 (SD=1.0) years. There were 23 Non-Smartphone Addictive College Students (NSACS, 20 females, 3 males), they ranged in age from18 to 22 with an average age of 20.03 (SD=1.0).

Materials, procedure and apparatus

Questionnaire: Participants were recruited through a questionnaire including several questions about basic information about participants (gender, age, grade and contact way) and Smartphone Addiction Scale For College Students (SAS-C) developed by Su, Pan [8]. The SAS-C contains 22 items with six dimensions: withdrawal behavior, salience behavior, social comfort, negative effects, and use of App and update of App. Each item was scored on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). According to the results about Pathological Internet Use [30] and our survey results, college students who scored higher than 77 were classified as Smartphone Addictive College Students (SACS), college students who scored lower than 66 were classified as Non-Smartphone Addictive College Students (NSACS). In addition, students were asked to write down ten Apps they used most frequently.

Materials: Firstly, a large number of smartphone brand pictures, smartphone pictures and App pictures were downloaded from the internet; pictures about a female/male using smartphone were taken by a photographer. Secondly, all pictures were selected by experts, the results of interviews and App nomination of college students. Thirdly, preliminary experiment including 8 college students with and 7 college students without smartphone addiction was conducted to test the feasibility of the pictures and experiment. Finally, 14 smartphone brand pictures, 12 smartphone pictures, 40 App pictures and 30 pictures about a female/male using smartphone were re-selected. The pictures included in current study consisted of 96 smartphone-related pictures. All pictures had a standardized image size (300×300 pixel) and similar format (ambiguous in specific information and blank in background) (Figure 1).

Rating manual: Every picture was matched with an item in the rating manual by asking participants to rate picture on four dimensions from 1 to 9: Pleasantness (1=very unpleasant, 9=very pleasant), Attractiveness (1=totally not attractive, 9=very attractive); Familiarity (1=never see this picture before, 9=very impressive and very familiar with this picture), Craving (1=totally don't want to play with a smartphone because of this picture, 9=really want to play with a smartphone immediately).

Procedure: All the 96 pictures were pseudorandom and presented in E-prime 2.0 on a computer. The procedure was as follows: in the beginning, a cross was presented at the center of the screen for 300 ms, followed by a smartphone-related picture, the picture remained until participants rated this picture in four dimensions and pressed button "q". After this response, the next fixation cross emerged

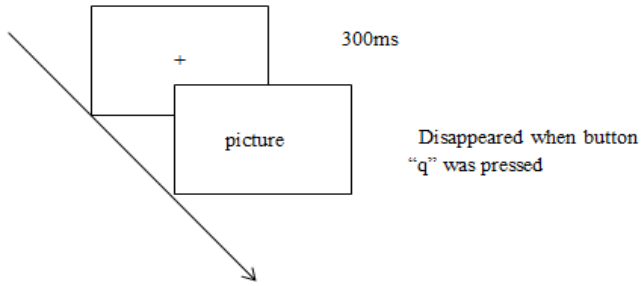

Figure 2: Procedure of picture rating task.

instantly. This procedure was depicted in (Figure 2).

Results

Correlations

The correlations of the rating scores of four dimensions of smartphone-related pictures were summarized in (Table 1). The rating scores of the four dimensions of smartphone-related pictures of SACS and NSACS were all significantly positively correlated.

Rating scores difference between SACS and NSACS

The difference of rating scores between SACS and NSACS were significant and rating scores of SACS were all significantly higher than that of NSACS on four dimensions (Table 2).

Differences of rating scores between App-related pictures and other kinds of pictures

Since one of the most significant differences between smartphone and traditional cellphone is the large amount of Apps could be employed in smartphone [8], there were significant differences between addicts and non-addicts in terms of the App usage frequency and App category preferences [18], the rating differences between App pictures and other three kinds of smartphone-related pictures were investigated. Rating scores of App pictures were significantly higher than other three kinds of smartphone-related pictures in pleasantness and attractiveness, while there were no significant differences between rating scores of App pictures and other three kinds of smartphone-related pictures in familiarity and craving (Table 3).

Discussion

Our study focused on standardizing smartphone-related pictures that would be used in the development and validation of smartphone cue reactivity tasks for SACS, these pictures were rated on pleasantness, attractiveness, familiarity and craving. Finally, the database of 96 smartphone-related pictures was established.

By standardizing smartphone-related pictures, our study was the first to investigate the rating biases toward smartphone-related pictures among smartphone addicts. The results showed a significant difference of rating scores in smartphone-related pictures between SACS and NSACS groups, which was consistent with previous studies [22, 23,25]. The results confirmed that addiction-related cues were more pleasant, attractive, and familiar and could induce more craving for addicts. The rating differences between App pictures and other three kinds of smartphone-related pictures in pleasantness and attractiveness may reveal some specific features of smartphone which would inspire the work of Apps design. Besides, the rating scores in four dimensions of smartphone-related pictures were positively related, which had not been reported in previous studies, one possible explanation is that habitual smartphone use (familiarity) could result in addictive smartphone behaviors, and smartphone addicts could be rewarded by addiction-related cues (pleasantness). Addiction-related cues could grab smartphone addicts' attention (attractiveness) and elicit their craving to use smartphone [27]. Generally, our study could provide some evidence for the rating biases among smartphone addicts and primarily set up the categories of smartphone-related pictorial cues, which could be helpful in further studies about smartphone addition (e.g. attentional bias, emotional bias and so on). Additionally, clinicians or therapists could employ similar approaches according to our results as implicit methods in practice to assess the smartphone addicts' symptoms, such as using rating bias toward smartphone-related cues to increase the validity of measurement or diagnosis of smartphone addiction [22,27]. The limitations of this study should be noted. First, the unbalance of participants' gender might influence the standard of pictures. Though

Table 1: Correlations of four dimensions of smartphone-related pictures (r, n=96).

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Y(Pleasantness)	1											
2.	Y(Attractiveness)	0.94**	1										
3.	Y(Familiarity)	0.52**	0.60**	1									
4.	Y(craving)	0.76**	0.87**	0.71**	1								
5.	N(Pleasantness)	0.86**	0.81**	0.51**	.66**	1							
6.	N(Attractiveness)	0.85**	0.85**	0.55**	.71**	0.95**	1						
7.	N(Familiarity)	0.36**	0.43**	0.88**	.60**	0.46**	0.49**	1					
8.	N(craving)	0.73**	0.79**	0.64**	0.80**	0.81**	0.89**	0.63**	1				
9.	T(Pleasantness)	0.96**	0.91**	0.55**	0.73**	0.97**	0.94**	0.44**	0.80**	1			
10.	T(Attractiveness)	0.86**	0.87**	0.51**	0.71**	0.82**	0.85**	0.37**	0.73**	0.87**	1		
11.	T(Familiarity)	0.43**	0.50**	0.95**	0.67**	0.48**	0.51**	0.98**	0.64**	0.49**	0.43**	1	
12.	T(craving)	0.73**	0.84**	0.71**	0.94**	0.72**	0.81**	0.66**	0.94**	0.76**	0.72**	0.70**	1

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$.
Participants with smartphone addiction were represented by "Y", participants without smartphone addiction were represented by "N".

Table 2: The rating differences between SACS and NSACS.

	SACS (n=18)			NSACS (n=23)		
	App (n=40)	Other kinds (n=56)	t	App (n=40)	Other kinds (n=56)	t
Pleasantness	5.76±0.91	4.63±0.90	6.017***	5.07±0.76	4.32±0.81	4.618***
Attractiveness	5.56±1.03	4.66±0.95	4.392***	5.00±0.77	4.34±0.80	4.015***
Familiarity	6.55±1.68	6.45±0.81	0.386	6.08±1.54	6.39±0.72	-1.183
Craving	5.07±1.26	4.98±0.86	0.446	4.42±0.98	4.20±0.70	1.285

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$.

Table 3: The rating differences between App pictures and other kinds of pictures.

	SACS (n=18)	NSACS (n=23)	t
Pleasantness	5.10±1.06	4.64±0.87	8.510**
Attractiveness	5.03±1.08	4.62±0.85	7.052**
Familiarity	6.49±1.24	6.26±1.14	3.715**
Craving	5.02±1.04	4.29±0.83	11.437**

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$.

Su, Pan [8] did not find any difference between females and males in scale scores and gender difference about addicts' cognitive biases had not been reported in previous researches. However, possible gender difference in smartphone addiction had been discussed. Van Deursen, Bolle [5] proposed that females were more likely to have habituated smartphone use behavior or addictive behavior. Aljomaa, Al.Qudah [31] reported significant gender differences among college students. Therefore, gender balance should be considered in further studies to investigate the potential gender differences. Second, only four kinds of smartphone-related pictures were included in present study which might limit the generalization of results and more categories should be adopted in further studies Third, smartphone addiction and internet addiction are overlapped with social applications addiction [5], thus research about the unique characteristics of usage of social applications of smartphone addicts are needed.

Furthermore, with the rapid update and development of smartphone technology, new feature of smartphone addiction may come out, and other possible cognitive biases like attentional and approach biases should be examined [23-25,27,32]. Clayton, Leshner [4] found that when iPhone users were completing a word search task while they could not answer their ringing iPhone (the iPhone was separated from the participants), their heart rates, blood pressure, level of self-report anxiety and extended self (i.e. the participants would highly regard their iPhone as one part of themselves) would be higher than when they were calm. Compared with the word search task performance when they were holding their iPhone, participants' performance was poorer when they were separated from their iPhone. In conclusion, iPhone users' cognitive abilities were diminished when they were separated from their ringing iPhones. Traylor, Bordnick [33] found that when the youth who smoked were in smoking environment of virtual reality, their attention to smoking cues and thoughts about smoking significantly increased. In light of these studies, we might observe the effects of Apps' warning tone (wechat, QQ, et al.) on smartphone users could be observed, more attention should be paid to the uniqueness of smartphone, and the features of virtual reality in the situations where could possibly use smartphones could be explored.

Conclusion

In sum, smartphone addicts showed a rating bias on smartphone-related cues and the current study standardized a set of smartphone-related pictures that could be employed in smartphone cue reactivity tasks and implicit measures (e.g. attention and approach biases) to study cognitive biases in college students with smartphone addiction.

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