Validation of Emotional Stimuli Flashcards for Conducting 'Response to Reward' fMRI Study among Malaysian Undergraduates

(Pengesahan Kad Imbasan Rangsangan Emosi untuk Menjalankan Kajian 'Tindak Balas terhadap Ganjaran' fMRI dalam Kalangan Mahasiswa Malaysia)

NISHA SYED NASSER, HAMED SHARIFAT, AIDA ABDUL RASHID, SUZANA AB HAMID, EZAMIN ABDUL RAHIM, MAZLYFARINA MOHAMAD, ROHIT TYAGI, SITI IRMA FADHILAH ISMAIL, CHING SIEW MOOI & SUBAPRIYA SUPPIAH*

ABSTRACT

Problematic Instagram Use (PIGU) is a specific Internet addiction disorder observed among the youth of today. Functional magnetic resonance imaging (fMRI) can objectively assess regional brain activation in response to addiction-specific rewards, e.g. viewing picture flashcards. Pictures that were uploaded onto Instagram by users with PIGU issue have often been associated with risky behaviors in their efforts to gain more 'Likes'. Thus, it was hypothesized that individuals with PIGU issue are more drawn to negative emotional cues. To date, no literature on addiction-specific cues found on the local database. The objective of this study was to conduct an out-of-scanner validation study to create a database of pictures with negative emotional cues that evoke responses of arousal among individuals with PIGU issue. Forty-four Malaysian undergraduates (20 undergraduates in the PIGU group, 24 undergraduates in the control group) were randomly recruited as the subjects in the present study. They were grouped into PIGU or control groups based on the evaluation using the Smartphone-Addiction-Scale-Malay version (SAS-M) and modified Instagram Addiction Test (IGAT) and whether they fulfilled the definition of addiction according to Lin et al. (2016). They were administered with 200 content-specific pictures that were multidimensional, i.e. arousal (excitation or relaxation effects), approach-avoidance (motivational direction) and emotional valence (positive or negative feelings) to describe their perceptions on the psychological properties of the pictures using a 9-point Likert scale. The results showed that the subjects with PIGU issue, who viewed the negative emotional cues, demonstrated significant positive correlations between arousal and valence ($z = 4.834$, $p < .001$, effect size = 0.69) and arousal and avoidance-approach ($z = 4.625$, $p < .001$, effect size = 0.66) as compared to the controls and were more frequently aroused by negative emotional type of stimuli. As a conclusion, a database of validated, addiction-specific pictures can be developed to potentiate any future cue-induced response to reward fMRI studies for assessing PIGU.

Keywords: Addiction; affective ratings; cravings; picture database; reward

ABSTRAK

Penggunaan Instagram yang Bermasalah (PIGU) adalah sejenis gangguan khusus ketagihan Internet dalam kalangan belia masa kini. Pengimejan resonans magnet kefungsian (fMRI) dapat menilai pengaktifan otak serantau sebagai tindak balas terhadap ganjaran khusus ketagihan, contohnya melihat gambar kad imbasan. Gambar yang dimuatnaik dalam aplikasi Instagram oleh pengguna yang mempunyai isu PIGU sering dikaitkan dengan kelakuan berisiko dalam usaha mereka mengaut 'Likes', maka hipotesis kami ialah individu yang mempunyai isu PIGU akan lebih tertarik kepada gambar rangsangan emosi negatif. Sehingga kini, tidak terdapat mana-mana pangkalan data tempatan dengan set gambar-gambar ketagihan yang berkaitan dengan PIGU yang boleh menimbulkan rasa teruja. Objektif kajian ini ialah untuk menjalankan kajian pengesahan di luar mesin MRI untuk mewujudkan pangkalan data gambar yang membawa isyarat emosi negatif yang dapat merangsangkan individu yang mempunyai isu PIGU. Empat-puluh-empat pelajar siswazah Malaysia (20 siswazah dalam kumpulan PIGU, 24 siswazah dalam kumpulan kawalan) telah dipilih melalui persampelan rawak mudah sebagai subjek kajian ini. Penarafan persepsi dilakukan berdasarkan dimensi keghairahan (kesan teruja atau relaks), dan pendekatan-menghindari (motivasi pergerakan) dan valensi (emosi positif atau negatif). Keputusan kajian menunjukkan subjek yang mempunyai isu PIGU mempunyai korelasi positif yang signifikan terhadap rangsangan dan valensi ($z = 4.834$, $p < .001$, saiz kesan = 0.69) dan pendekatan rangsangan dan menghindari ($z = 4.625$, $p < .001$, saiz kesan = 0.66) berbanding subjek kawalan apabila melihat gambar emosi negatif. Kesimpulannya, pangkalan data gambar-gambar khusus ketagihan yang disahkan dapat menimbulkan keinginan dan motivasi untuk mendekati individu yang mempunyai isu PIGU yang dapat dikaji menggunakan fMRI pada masa hadapan.

Kata kunci: Ganjaran; keghairahan; ketagihan; pangkalan data; penilaian affektif

INTRODUCTION

Problematic Instagram Use (PIGU) is a behavioural addiction (BA) and it is considered as a type of specific Internet addiction, which is associated with cravings and overdependence of using Instagram social networking application (SNA) despite experiencing deterioration in daily living activities among the addicted individuals. In other words, addiction is defined as a compulsive behavior associated with continued indulgence in pleasure-seeking activities with no desire to give up despite the detrimental effects (Volkow et al. 2016). Addiction is classically recognized as substance use disorders (SUDs) such as addiction to cannabis, tobacco, alcohol, hallucinogens, sedatives, caffeine, opioids, hypnotics, and anxiolytics. Nevertheless, it also encompasses abnormal behaviors such as pathological gambling and preoccupation with the Internet, online gaming and social networking (American Psychiatric Association 2013).

Instagram use among Malaysians has increased exponentially in the past decade giving rise to problematic behaviors related to its use (Khalid et al. 2018). Most studies in the past relied only on questionnaire-based assessments such as the Smartphone Addiction Scale-Malay version (SAS-M) and modified Instagram Addiction Test (IGAT) (Ching et al. 2015; Nisha et al. 2019) to establish commonalities between PIGU and other types of addictions like BA and SUDs and lacking in neurobiological evidence to support their hypotheses. Functional magnetic resonance imaging (fMRI) is a neuroimaging technique that can be used to obtain the related neurobiological evidence as it can objectively assess regional brain activations in response to addiction-specific rewards. In addition to using the questionnaire-based assessments, PIGU can also be assessed by a set of modified diagnostic criteria for smartphone addiction, which is an objective assessment proposed by Lin et al. (2016).

In the present study, PIGU was assessed using the modified diagnostic criteria for smartphone addiction by replacing the words 'the Smartphone' with 'Instagram' and the sensitivity, specificity and diagnostic accuracy after the modification were 79.4, 87.5, and 84.3%, respectively. The criteria comprise of three parts that assess the symptoms or behavior of the subject in the last three-month period; Criterion A: presence of at least three out of the six symptoms (Repeated inability to resist using the Smartphone, Withdrawal symptoms like dysphoric mood, irritability and anxiety when away from the Smartphone for any period of time, Prolonged usage of the Smartphone that exceeds the initially intended duration, Unsuccessful attempts to reduce the Smartphone usage, Excessive preoccupation with the Smartphone or the thoughts of quitting it, Continued excessive use of the Smartphone despite knowledge

of having a persistent or recurrent psychological or physical problem as a result of its overuse); Criterion B: presence of at least two out of the four functional impairment criteria in which the words 'Smartphone use' or 'SPU' were replaced with 'Instagram' in the present study (Recurrent psychological or physical problems as a result of excessive SPU, Physically dangerous, risky or hazardous situation (e.g. SPU while driving or crossing a road) or having other detrimental impacts on daily living due to SPU, Impairment in school achievements, interpersonal relationships or job performances caused by SPU, Significant subjective distress or time consumption due to excessive SPU); and Exclusion criteria: BAs that cannot be explained clearly with any underlying psychiatric condition such as bipolar disorder or obsessive-compulsive disorder (Lin et al. 2016).

The fMRI can illustrate the *in vivo* brain activations from the 'Response to Reward' conditions and contributes to the neurobiological understanding of this type of addiction (Kim et al. 2014; Sun et al. 2012; Zhang et al. 2016). Task-based fMRI employs blood oxygen level-dependent imaging (BOLD) to measure the hemodynamic response function (HRF), i.e. outshoot of oxygenated blood to local brain areas, which is activated during tasks such as viewing pictures, videos and decision-making in the cerebral cortex (Glover 2011; Huettel et al. 2014; Lindquist et al. 2009; Sharifat et al. 2018). According to the incentive-sensitization theory of addiction, attention bias and pathological motivation toward addiction-related cues such as pictures, movies and words tend to elicit higher levels of arousal or cravings in addicted individuals (Robinson & Berridge 2008).

A paradigm was defined by Capra (1996) as a group of values, concepts, perceptions, and practices that are shared by a community, which forms a unique vision of reality that becomes the foundation of the way a community organizes itself. It is used to investigate individual differences, group behaviors, organizational behaviors, human factors, and cognitive behaviors among a group of subjects. In specific, an experimental fMRI paradigm refers to a temporal allocation of stimuli to obtain functional BOLD by employing sensory cues, e.g. emotional visual stimuli that are embedded in a block or event-related design to evoke HRF in a subject (James et al. 2014). A proper fMRI paradigm design enables the researcher to obtain a good response accuracy and subsequently, identify regional brain activations in response to the stimulus being presented.

Increased craving or euphoria in an addicted subject can be studied using cue-reactivity paradigms, where emotional visual cues are used to elicit feelings of arousal and craving during reward anticipation or 'Response to Reward' during reward delivery from the pathological subject and the obtained observations are

compared with the control group. It is one of the widely employed paradigms that is used to evoke and evaluate the craving for pathological gambling, Internet addiction, smartphone addiction and pathological Instagram and Facebook usage (Brand et al. 2016; Chakraborty 2016; Ko et al. 2009; Nisha et al. 2019; Niu et al. 2016; Sherman et al. 2018). The study of emotions is a relatively new parameter with regards to the study of PIGU. To date, the exact nature of emotional and motivational states in PIGU has not yet been adequately understood. Emotional stimuli are characterized by dimensions such as arousal, approach-avoidance (motivational direction) and emotional valence to describe human perceptions of the physical properties of the stimuli. Valence describes the positive or negative feelings evoked by the visual cues.

Arousal is a physiological activity ranging from aroused or excited to unaroused or relaxed. Motivational direction refers to the directional aspect of one's behavior, i.e. the decision of an individual to move towards or approach the stimuli or move away or avoid the stimuli (Feldman-Barrett et al. 2006; Mauss & Robinson 2009). Studies related to SNA identified that the youth of today (the young adults) tend to post 'selfies' on social media to gain 'Likes' as a way to gain peer approval and popularity (Sherman et al. 2018). Risky and negative emotional valence type of posts, which often contain photos taken from dangerous locations such as from heights, rooftops, towers, near railway lines and on the road and photos suggesting problematic interpersonal relationships such as with ex-boyfriends or ex-girlfriends, are often uploaded to receive 'Likes' from their peers (Kurniawan et al. 2017).

Furthermore, evidence of risky lifestyle behaviors such as taking illicit drugs, alcoholism and eating disorders among the youth of today can be found through data mining on publicly available Instagram posts (Zhou et al. 2017). Thus, the present study hypothesized that the risky and negative emotional pictures are acting as rewarding visual cues that effactually modulate emotional experiences among PIGU in young adult group. Hence, appropriate emotional cues for neuroimaging studies can be selected based on the ratings of the dimensional categories.

Validated flashcard sets or image databases are invaluable for an excellent cue-induced reactivity fMRI study. Even though there are available standard databases that contain emotionally-charged stimuli such as the International Affective Picture System and the Geneva Affective Picture Database, but there is no particular database on Smartphone-linked Instagram addiction. Thus, there is a lack of appropriate and validated images that can be used for the future cue-induced fMRI studies to evaluate the 'Response to Reward' condition among social networking addicts, particularly those with PIGU issues.

To date, no local database provides addiction-specific cues on PIGU that can elicit robust brain activations and portray similar neurobiological mechanisms as shown in SUDs. The main objective of the present study was to validate a set of flashcards that can induce negative emotional valence and potentially elicit brain activations in subjects with PIGU issue. The present study aimed to create a database of neutral cues as the baseline and negative emotional cues as the rewarding cues for the future fMRI studies on PIGU. This validation study was designed and modified based on the method used by the Nencki Affective Picture System (NAPS) (Marchewka et al. 2014).

MATERIALS AND METHODS

The 'Response to Reward' condition employing negative emotional stimuli and neutral cues was evaluated using the modified Sherman's method (Sherman et al. 2016). The pictures for the present study were selected from publicly available Instagram accounts after receiving approval from the respective account holders. The collected pictures were classified into two categories: Negative emotional cues and neutral cues. The negative emotional cues category included photos such as 'selfies' taken from heights, photos taken while driving, photos suggesting loss of an interpersonal relationship and photos taken while doing dangerous and risky stunts. While the neutral cues category included pictures of landscapes, plants, trees, and objects in a greyscale background. Pictures with greyscale background were selected as neutral cues for the present study because they provide very little information and elicit less interest compared to colored images, hence, reduce the involvement of the human visual system in extracting information from the pictures (Kather et al. 2017).

The initial classification of pictures was done by the principal team members (NSN, HS, AAR, SS). The selected pictures were then shown to three independent consultants (CSM, SIF, MFM) to obtain their impartial opinion on the pictures in consensus. They acted as the impartial judges in the classification of the pictures. Bright and colorful pictures that can provoke any positive emotions or a feeling of arousal were excluded from the neutral cues category. Photos taken in religious or sacred places were excluded from the negative emotional cues category to avoid any possible disputes. Any blurred photos were excluded from both categories. A total of 300 pictures were preliminarily selected at the beginning of the present study for further classification. All the judges were in consensus during the picture classification for 99% of the pictures (Cronbach's α = .99). The finalized pictures (n = 200; 100 pictures in negative emotional cues category and 100 pictures in neutral cues category) were then processed according to the specifications of the fMRI

paradigm. The pictures were resized and cropped to 600 × 400 pixels with a resolution of 300 dpi using the freely available software, namely Irfan View (sourced from https://www.irfanview.com/). The pictures were in JEPG file format.

PARTICIPANTS

After acquiring the ethical clearance from the local institutional committee (JKEUPM; UPM/TNCPI/RMC/1.4.18.2), the validation study was conducted among the 44 undergraduates, where 20 of them were in the PIGU group (16 females and 4 males; mean age 22.05 years) and 24 of them were in the control group (18 females and 6 males; mean age 21.75 years) from Universiti Putra Malaysia. The subjects were recruited based on the evaluation using the online SAS-M and modified IGAT questionnaires. The subjects who attained a total score of ≥98 on the SAS-M and ≥37 on the modified IGAT (the recommended cut-off scores for the questionnaires) as well as fulfilled the diagnostic criteria proposed by Lin et al. (2016) were grouped to the PIGU group. Conversely, those who attained a total score that was lower than the recommended cut-off scores and did not fulfil the diagnostic criteria were categorized as controls. The recruitment of the subjects for the present study was done by advertising on the student portals and via communication with undergraduates through lecturers in all the faculties of Universiti Putra Malaysia (UPM). The responding undergraduates were from various faculties of UPM and they were further selected and recruited to the present study using the simple random sampling method. Informed consent was obtained from all the subjects. The present study abided by the rules advocated by the Declaration of Helsinki 1964.

RATING SCALES AND STIMULI PRESENTATION

Before the commencement of the present study, a briefing session was conducted for the subjects. The subjects were instructed to answer the questions honestly and without discussing it with others. The stimuli from both the categories were presented alternatively to the subjects with the limitation that no more than three stimuli from each category should be presented in sequential succession. The subjects were instructed to view each picture for three seconds and then respond to three sub-questions related to emotional valence, motivational direction and arousal, where each question need to be answered in three seconds (Supplementary file 1).

An online picture evaluation method was used to rate the flashcards on a nine-point rating scale. The subjects were requested to complete the sentence on the valence scale, "You are judging this picture as ..." (from 1 = very negative to 9 = very positive, with 5 = neutral). Then, the subjects were requested to judge the motivational direction by completing the sentence, "My reaction to this picture is ..." (from 1 = to avoid to 9 = to approach, with 5 = neutral). Lastly, the subjects were requested to judge the degree of arousal elicited by the pictures with the introductory sentence, "Confronted with this picture; you are feeling: …" (From 1 = relaxed to 9 = aroused, with 5 = neutral or ambivalent). The duration of the study was 45 min. The validation form was emailed to the subjects and their responses were collected via an online link. All responses were further analyzed using the statistical package SPSS version 22.

RESULTS

The ratings and descriptive statistics for the dimensions and pictures in each category by groups are presented in

TABLE 1. Descriptive statistics calculated separately for each dimension and category in the target groups

Category		PIGU group			Control group		
		A	B	C	A	B	C
Negative	Mean±	5.005±	4.83±	5.60±	4.445±	4.304±	5.697±
Emotional	SD	0.945	0.941	0.480	1.020	1.020	0.643
	Min-Max	2.60-7.1	2.45-7.1	3.9-6.8	2.67-7.21	2.5-7.08	3.83-7.13
	N	100	100	100	100	100	100
Neutral	Mean±	6.165±	6.011±	4.765±	6.292±	6.294±	4.043±
	SD	0.613	0.607	0.452	0.639	0.684	0.636
	Min-Max	3.7-7.5	3.5-7.35	3.65-5.7	4.08-7.63	3.96-7.58	2.83-5.71
	N	100	100	100	100	100	100
Negative	Mean±	5.585±	5.420±	5.187±	5.369±	5.299±	4.87±
Emotional	SD	0.986	0.987	0.629	1.256	1.322	1.046
and Neutral	Min-Max	2.60-7.5	2.45-7.35	3.65-6.8	2.67-7.63	2.5-7.58	2.83-7.13
Combined	N	200	200	200	200	200	200

SD: Standard Deviation; A: Valence; B: Approach-Avoidance; C: Arousal; Min-Max: Minimum-Maximum value; N = Number of pictures

Table 1. The PIGU and control groups showed differing emotional responses to the negative emotional cues. For the subjects in the PIGU group, the negative emotional cues elicited positive feelings and they were aroused and preferred to approach those pictures. Whereas for the subjects in the control group, although the negative emotional cues also aroused them, they preferred to avoid those pictures. Both the groups rated the neutral cues as pleasant and relaxing or un-arousing and apted to approach those pictures.

CORRELATION ANALYSES OF EMOTIONAL DIMENSIONS FOR THE GROUPS AND CATEGORIES

By treating the pictures as cases, correlation analyses were conducted using the Pearson's correlations to examine the relationships between the ratings of valence, arousal, and approach-avoidance for each category and group separately (Table 2, Figures 1 to 3). All the dimensions were highly correlated in both the PIGU and control groups ($p < 0.001$) as demonstrated in Table 2. The control group, however, had a strong negative correlation compared to the PIGU group in all cases, except for the correlation between approach-avoidance and arousal, in which both groups exhibited a strong positive correlation. The correlation coefficients of the control group were also directly compared to those of the PIGU group through the calculation to test the difference between the two independent correlation coefficients (Preacher 2002). The calculation involved the conversion of the two correlation coefficients into z scores using Fisher's r-to-z trans-

formation. Then, the employed sample size was used to obtain each coefficient and the z scores were compared using the Formula 2.8.5 from Cohen and Cohen (1983) as follows:

$$Z = Z1 - Z2/SDZ$$

where Z1 is the correlation coefficient for PIGU group; Z2 is the correlation coefficient for the control group; and $SDZ = \sqrt{[1/(N1 - 3) + 1/(N2 - 3)]}$ in which case N1 and N2 are the sample sizes for each group. For the correlation between the emotional valence and arousal, the differences between the PIGU and control groups for the negative emotional category showed a strong positive effect ($z = 4.834$, $p < .001$, effect size = 0.69) compared to the control group-PIGU group, which showed a strong negative effect ($z = -4.83$). Similarly, for the correlation between the arousal and approach-avoidance, the differences between the PIGU and control groups (PIGU group-control group) for the negative emotional category showed a strong positive correlation ($z = 4.625$, $p < 0.001$, effect size = 0.66) compared to the control group-PIGU group, which showed a strong negative correlation ($z = -4.625$). For the correlation between the emotional valence and approach-avoidance, the differences between the control group-PIGU group for the negative emotional category showed a moderate positive correlation ($z = 2.32$, $p < 0.001$, effect size = 0.33) compared to the PIGU group-control group, which showed a moderate negative correlation ($z = -2.32$).

TABLE 2. Pearson's correlation coefficient of the ratings of valence, arousal and approach-avoidance for each category in the target groups

Category	Dimension	PIGU group Pearson's 'r'		Control group Pearson's 'r'	
		C	A	C	A
Negative Emotional	A	-.372*		-.795*	
	B	-.423*	.971*	-.806*	.985*
Neutral	A	-.716*		-.895*	
	B	-.745*	.944*	-.905*	.980*

A: Valence; B: Approach-Avoidance; C: Arousal. *Correlation is significant at p < 0.05

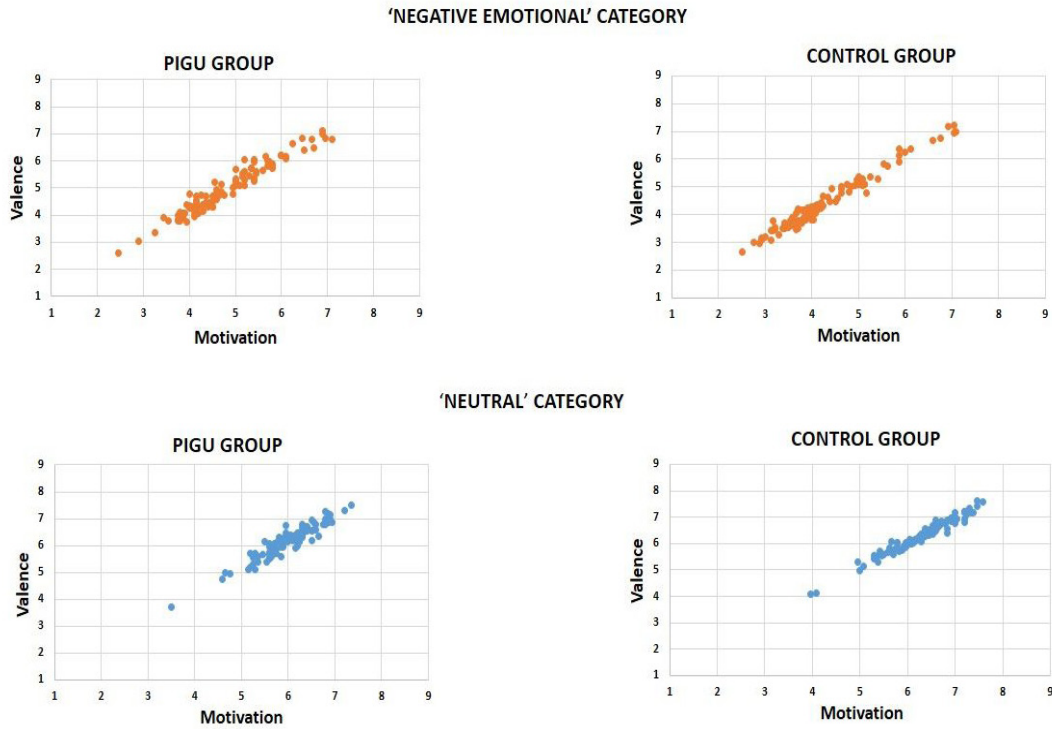**'NEGATIVE EMOTIONAL' CATEGORY**

FIGURE 1. Scatter plot chart depicting the relationship between the scores from the PIGU and control groups for the two picture categories shows the behavioral ratings for the emotional valence (y-axis) and motivational direction (x-axis) in each category from the PIGU and control groups
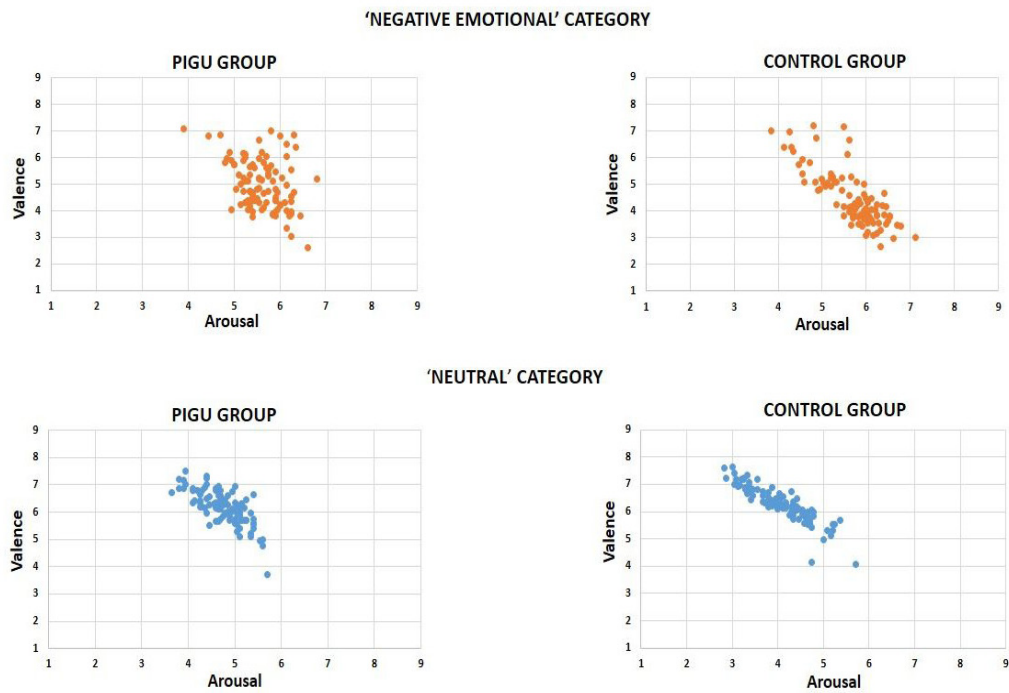* Every single dot represents the mean rating for a particular picture on a two-dimensional scale
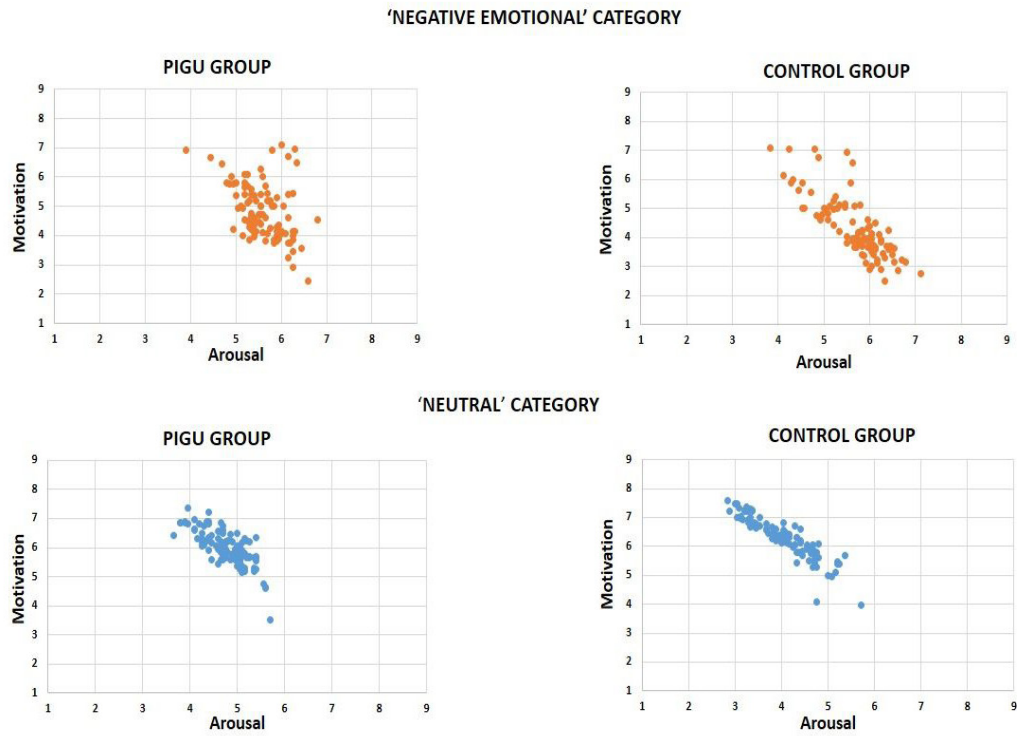
'NEGATIVE EMOTIONAL' CATEGORY

FIGURE 2. Scatter plot chart depicting the relationship between the scores from the PIGU and control groups for the two picture categories shows the behavioral ratings for the emotional valence (y-axis) and arousal (x-axis) in each category from the PIGU and control groups
* Every single dot represents the mean rating for a particular picture on a two-dimensional scale

'NEGATIVE EMOTIONAL' CATEGORY

'NEUTRAL' CATEGORY

FIGURE 3. Scatter plot chart depicting the relationship between the scores from the PIGU and control groups for the two picture categories shows the behavioral ratings for the emotional valence (y-axis) and arousal (x-axis) in each category from the PIGU and control groups
* Every single dot represents the mean rating for a particular picture on a two-dimensional scale

DISCUSSION

The present study focused on the development and validation of the visual cues, namely Problematic Instagram Use Flashcards that consists mainly of negative emotional valence cues, which can evoke an emotional response of arousal and tendency to approach among the problematic Instagram users in the young adult age group. While the neutral cues can act as the baseline stimuli to the addiction-specific cues in the future fMRI studies.

The classification of the pictures was a significant step in the development of the database. The pictures were classified into two categories: Negative emotional cues and neutral cues. The negative emotional cues included pictures denoting PIGU such as pictures taken from high altitude, texting while driving, dangerous stunts, and pictures suggesting loss of an interpersonal relationship in which the subject with PIGU issue could perhaps relate to and deem as arousing. While the neutral cues involved scenic pictures with dull-colored background and photos of objects in grayscale, which were used as the baseline stimuli. All the pictures in the database were of excellent quality with a resolution of 300 dpi. The correlations between the emotional valence, arousal and approach-avoidance for the negative emotional and neutral categories were determined based on the scores from the PIGU and control groups.

The results suggested that there was a distinct profile for the PIGU group with regards to their experience of emotions when they were presented with the negative emotional cues that we deemed as addiction-specific cues. Both the arousal and emotional valence and the arousal and avoidance-approach showed a strong positive correlation in the PIGU group as compared to the control group for the negative emotional cues. The PIGU group were more vulnerable to the addiction-specific cues and more frequently aroused by the negative emotional type of stimuli compared to the control group as they are frequently using such type of pictures to gain more 'Likes' on Instagram. When analyzing the relationship between the emotional valence and motivation among the controls, the results showed that the pictures in the negative emotional category were rated as unpleasant and hence, they perceived it as negative and would prefer to avoid these cues.

In contrast to the control group, the PIGU group had abnormal perceptions of the negative emotional cues and rated these stimuli as pleasant. This could be due to their abnormally accentuated needs to gain popularity and acceptance among their peers, which has forced the subjects with PIGU issue to indulge actively in risk-taking behaviors and increase their motivation in seeking risky situations. These findings are in line with the study by Volkow et al. (2010) where a greater activation of the motivation circuit upon exposure to drug cues was observed and ultimately, resulted in the compulsive intake of illicit drugs. The addicted participants in the study by Volkow et al. (2010) showed a tendency to approach the negative emotional cues.

The results showed that the neutral cues did not elicit any excitement or arousal from both the PIGU and control groups. Interestingly, when the negative emotional cues were presented, both groups reported increased ratings for arousal. This finding is consistent with the studies on the Internet and alcohol addictions, which reported the non-addicts could also get aroused in response to the addictive cues (Niu et al. 2016; Sinha & Li 2007). The addictive cues may occasionally arouse non-addicts as they might associate this kind of pictures with themselves, friends or family members (Niu et al. 2016).

Although both groups were aroused upon exposure to the negative emotional cues, the mean rating of arousal in the control group was higher than that of the PIGU group. Some of the subjects in the control group were more aroused by the negative emotional cues, which might be due to their unfamiliarity to the pictures. Thus, they were excited when they were presented with the negative emotional cues, which are considered as 'taboo', socially unaccepted and should be discouraged (Duncan & Petosa 1994). Nevertheless, they correctly responded by avoiding such cues. As anticipated, the PIGU group were also aroused by the negative emotional pictures but tended to respond by approaching these cues. Nonetheless, a few subjects from the PIGU group showed reduced arousal, which might be due to the development of tolerance as the result of their over-involvement in extreme levels of risk-taking behaviors. The PIGU group are postulated to become very aroused to extremely negative emotional kind of pictures and tend to approach the negative emotional cues due to their chronic exposure to such content on their Instagram account.

Lastly, the age of an individual plays a significant role in processing emotional stimuli. It can also influence the degree of arousal and hence, affect the brain activation in fMRI studies. Previous studies found that older individuals, middle-aged individuals and younger adults differ in their perceptions and way of processing emotional stimuli. The study by Grühn and Scheibe (2008) reported that older individuals over-rated the emotional valence and arousal dimensions compared to younger adults (Grühn & Scheibe 2008). Whereas Gilet et al. (2012) reported that the middle-aged individuals showed intense mean rating for positive pictures compared to the older individuals. Thus, the present study limited the research to undergraduates of a similar age group from a public university in Malaysia to avoid any bias and disputes.

The results suggested that the PIGU can produce long-term alterations in the way the users experience emotions when presented with negative emotional cues. The decision-making capability towards negative emotional cues was stronger among the subjects in the control group, which guides them towards adaptive objectives rather than towards the negative emotional cues as observed among the subjects in the PIGU group. Furthermore, neuroimaging studies highlighted the role of emotional markers in decision-making (Bechara 2004; Bechara et al. 2002). The prefrontal cortex is the crucial brain area that responsible for decision-making to find solutions in each task and decides whether to 'go' towards or to 'inhibit' the stimulus. In agreement with these studies, the decision-making capability in the PIGU group was affected. The subjects in PIGU group were unable to exhibit the inhibitory response to negative emotional cues when they were presented with such stimuli (Nisha et al. 2020). The present study helps to explain why the use of Instagram increases the motivational behavior of the PIGU group towards negative emotional cues as opposed to the control group. One's incapability to regulate and control the negative behaviors may lead to a distorted perception of social norms.

A set of pictures that consists of 20 negative emotional and 20 neutral pictures were selected from both picture categories. The final 20 negative emotional pictures were selected on the basis that the pictures elicited positive feelings, arousal, and the tendency to approach among the subjects in the PIGU group, while rated as unfavorable and induced the tendency to avoid among the subjects in the control group. The pleasant and un-arousing pictures to both groups were selected as suitable neutral stimuli. The appropriate cues selected in the present validation study enable the researchers to identify the regional brain activation in the mesocorticolimbic system in the future fMRI studies.

The present study focused specifically on the risk-taking behaviors of the undergraduates who are in the young adult's age group. Hence, it is likely that the behavioral influence may vary among adolescents as reported by Sherman et al. (2018) and older adults who may be preoccupied with different types of social norms and lifestyle behaviors. Hence, future studies may design their paradigms to facilitate adolescents and adults who may require a different set of flashcards, which targeted to age-specific content, for the fMRI study. Another limitation of the present study is the small sample size and limited theme of flashcards stimuli. Further validation of the picture database employing computerized SAM or the slider scale methodology is recommended. Additionally, the exact duration of time the subjects took to answer each question was unknown as the assessments in the present study were conducted online. An additional minor limitation of the present study is the lack of very negative (low emotional valence) pictures with a high avoidance-approach outcome.

CONCLUSION

A validated database of flashcard pictures on PIGU was created to potentiate the future fMRI 'Response to Reward' cue-induced reactivity studies among young Malaysian adults. The database offers high-resolution addiction-specific cues that can potentially activate the mesocorticolimbic reward system of the brain during the fMRI procedure. The pictures from the database are available to interested researchers upon request made to the corresponding author.

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Nisha Syed Nasser, Hamed Sharifat & Subapriya Suppiah*
Centre for Diagnostic Nuclear Imaging
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM Serdang, , Selangor Darul Ehsan
Malaysia

Aida Abdul Rashid, Suzana Ab Hamid, Ezamin Abdul Rahim, Nisha Syed Nasser & Subapriya Suppiah*
Department of Radiology
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM Serdang, Selangor Darul Ehsan
Malaysia

Mazlyfarina Mohamad
Center for Diagnostic, Therapeutic & Investigative Studies
Faculty of Health Sciences
Universiti Kebangsaan Malaysia
Jalan Raja Muda Abdul Aziz
50300 Kuala Lumpur, Federal Territory
Malaysia

Rohit Tyagi
Aerobe Pte. Ltd.
Singapore

Siti Irma Fadhilah Ismail
Department of Psychiatry
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
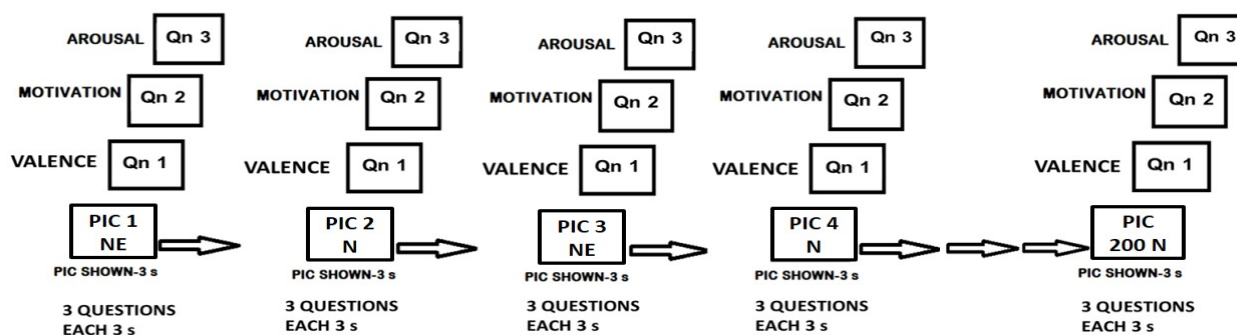43400 UPM Serdang, Selangor Darul Ehsan
Malaysia

Ching Siew Mooi
Department of Family Medicine
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM Serdang, Selangor Darul Ehsan
Malaysia

*Corresponding author; email: subapriya@upm.edu.my

SUPPLEMENTARY FILE 1. Stimuli presentation - the off-scanner paradigm

PIC: Picture; Qn: Question; NE: 'Negative Emotional' cues; N: 'Neutral' cues; s: Seconds