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Virtual Healing: Designing Reality

Editors:
Brenda K. Wiederhold, PhD, MBA, BCIA
Stéphane Bouchard, PhD
Giuseppe Riva, PhD, MS, MA

Interactive Media Institute
INTRODUCTION

One of the most distinctive features in the field of addiction is craving. It mainly refers to the desire or urge to experience the effect of a previously experienced psychoactive substance (UNDCP/WHO, 1992). It also represents the central dilemma of a fixation on addiction. Drug craving both contributes to the maintenance of substance abuse, and precipitates relapse following drug abstinence (Tiffany, 1990). According to these characteristics of drug craving, regular drug use will be associated with attentional biases for drug-related cues (Di Chiara, 2000). An attentional bias refers to a tendency for some cues to be selectively attended to, at the expense of other stimuli. In particular, differences in subjective craving are associated with attentional biases for drug-related cues among smokers. There is evidence that smokers, but not nonsmokers, show attentional bias for nicotine-related words on stroop and dot-probe tasks (Ehrman et al., 2002). Moreover, abstinence from smoking has been found to increase attentional bias on the stroop task in smokers (Gross, Jarvik, & Rosenblatt, 1993).

The measurement of eye movement is a sensitive method to identify attentional bias because eye movements are normally automatic, and are guided by changes in covert selective attention (Kowler, 1995). Although the controversy about exact measurement of attentional bias in eye movement remains, initial fixation and gaze duration can indicate attentional bias. There is evidence that, in comparison to nonsmokers, smokers initially fixate on smoking-related pictures more than on neutral pictures, and gaze at smoking-related pictures longer than neutral ones (Field, Mogg, & Bradley, 2004).

Another aim of the study was to investigate whether deprived smokers would have attentional bias to aversive cues, as compared to neutral cues. Signs and symptoms of nicotine withdrawal syndrome may include depressed mood, anger, and anxiety (APA, 1994). Once smokers feel anxious because of deprivation, they will show attentional bias to aversive cues. Anxiety in humans is characterized by specific biases that result in the preferential allocation of attention to stimuli that depict fear and threat (Eysenck, 1997). There is evidence that highly trait-anxious individuals show greater attentional bias for threat than for neutral faces (Mogg & Bradley, 1998).

In summary, smokers have increased craving and anxiety levels after nicotine deprivation, and in this state will show attentional bias towards specific cues. Therefore, we measured the direction of the initial fixation when smoking-related, aversive, and neutral cues were presented simultaneously on the computer screen. The percentage of numbers of initial fixation should reflect the initial focus of attention. We also investigated the overall amount of time that gaze was directed to the smoking-related, aversive, and control pictures over the course of picture presentation. This time measurement should indicate the maintenance of attention. Eye-movement monitoring enables us to measure the initial orienting and maintenance of attention, which is an advantage over other measures of attentional processing.

METHOD

Participants
We recruited participants (who were all students) from the C University located in Seoul, Korea. Initially, there were 34 participants. However, as two were unsuited to the calibration, and two did not meet the nonsmoker criteria, the total number of participants was 30. The
mean age was 21.7 years ($SD = 2.2$), and 17 participants were male. The group of 14 smokers consisted of ten males and four females, with a mean age of 22.5 years ($SD = 1.7$). On average, they smoked 10.1 cigarettes per day ($SD = 6.5$, range = 1–20) and had been smoking for 5.3 years ($SD = 2.7$, range = 1–8.5 years). The average time elapsed since smoking their last cigarette was 11.4 hours. The control group consisted of 16 nonsmokers (seven males and nine females), with a mean age of 20.9 years ($SD = 2.4$). Additional selection criterion for all participants was that they had eyesight within normal limits.

**Instruments**
The tasks were presented on a 1700 MHz PC (with 17” LCD-TFT monitor). Participants’ EMs were recorded during the experiment with a computerized eye-tracking system (Model iView X Hi-Speed, Applied Science Laboratories, Senso Motoric Instruments GmbH, Teltow, Germany).

We used the Questionnaire on Smoking Urges (QSU, Tiffany & Drobes, 1991) to measure each individual’s current urge to smoke and used the Spielberger Trait Anxiety Inventory (STAI, Spielberger, 1975) to measure the levels of state and trait anxiety. We also used the modified Fagerstrom Tolerance Questionnaire (mFTQ) to measure the degree of nicotine dependence. Participants completed a questionnaire about their personal details (age and sex), smoking habits, and smoking history.

**Procedure**
Two groups attended the laboratory. One group consisted of nonsmokers, and the other group consisted of smokers who were required to abstain from smoking for at least 4 hours before coming to the laboratory. Testing took place in a dimly lit, sound-proofed room.

At the start of the task, participants sat at a desk. We positioned the eye-tracking camera in front of the participant, below their left eye. The distance between the monitor and the eye tracker was 52 cm. The eye-tracking equipment was calibrated for each participant by presenting five small round dots on the screen (four at the each corner of the screen, and one in the center), and participants were required to look at each dot in turn, while their position of gaze was recorded.

In the eye movement task, each trial started with a central cross fixation shown for 1000 ms, which was replaced by the display of a pair of pictures, side by side, for 2000 ms. The intertrial interval was 1000 ms. There were five practice trials and 56 critical trials. The size of each picture was 135 mm high by 156 mm wide when displayed on the screen, and the distance between the inner edges of the pictures was 24 mm (visual angle of 2.6˚ between the fixation position and the inner edge of each picture).

After the computer task, participants completed QSU, STAI, mFTQ, and the questionnaire about smoking habits and history. After completion of the questionnaires, participants were thanked for their efforts and received a 10,000 won bill.

**Data analysis**
We analyzed the data using the BeGaze 1.0 Program (Senso Motoric Instruments). The direction of gaze, measured in degrees, was recorded 240 times per second. EM stability within 1˚ of the visual angle for 100 ms or more was classified as a fixation to that position, and the duration was recorded. Fixations were classified as being directed at the left or right pictures if they were more than 1˚ wide of the central position on the horizontal plane.

We used SPSS 11.5 for Windows for statistical analysis, and between subject t-test, one-sample t-test, and 2X3 repeated measures analysis of variance (ANOVA; between subject variables: smokers, nonsmokers; within subject variables: smoking-related, aversive, and neutral).

**RESULTS**
The mean age and levels of state and trait anxiety were not significantly different between the two groups.

**Eye movement results**
The percentages of initial fixation, and gaze duration are presented in Table 1.

**Direction of initial fixation**
We counted the number of initial fixations on each stimulus type and calculated them as a percentage. Scores greater than 50% reflect a bias in orienting towards smoking-related pic-
tures, relative to other pictures (50% indicates no bias). Smokers directed their gaze at smoking scenes on 51.5% of trials (SD = 5.2), and nonsmokers directed their gaze at smoking-related pictures in 48.8% of trials (SD = 5.0). These percentages of fixations indicate no bias compared to 50% (t(13) = 1.13, n.s., (t(15) = 0.95, n.s.). Smokers directed their gaze toward aversive pictures on 57.4% of trials (SD = 12.8), and this percentage of fixations was significantly greater than 50% (t(13) = 2.18, p < 0.05).

A 2X3 repeated measures ANOVA (group and picture type) showed a significant main effect of picture type (F(2,56) = 10.08, p < 0.01). Greenhouse-Geisser corrections to the degrees of freedom were used to adjust for violations of the sphericity assumption for repeated measures factors; only the correct probabilities are reported. There were no significant main effects of group (F(1,28) = 1.30, n.s.) and interaction (F(2,56) = 0.82, n.s.). Post hoc analysis showed that both groups initially fixated on aversive rather than neutral stimuli (Smoker: F(2,39) = 6.37, p < 0.01; Nonsmoker: F(2,45) = 7.85, p < 0.01).

Time of gaze duration
The mean amount of time that smokers spent fixating on smoking-related pictures was 889.18 ms (SD = 135.69), while nonsmokers spent 774.95 ms (SD = 129.01).

A 2X3 ANOVA (group and picture type) showed no significant interaction or main effect of group and picture type (interaction: F(2,56) = 1.81, n.s.; group: F(1,28) = 1.40, n.s.; picture type: F(2,56) = 1.25, n.s.). Post hoc analysis showed that smokers gazed toward smoking-related pictures significantly longer than nonsmokers did (F(1,28) = 5.58, p < 0.05).

DISCUSSION

The results from eye movement monitoring data provide proof of biases in visual orientation to smoking-related and aversive cues in smokers. Smokers showed attentional bias on smoking-related and aversive cues. Their initial fixation to aversive cues was significantly higher than chance and they had significantly longer gaze duration toward smoking-related cues than nonsmokers did.

In the initial fixation data, a 2X3 ANOVA showed a significant main effect of picture type. In post hoc analysis, both groups initially fixated on the aversive stimuli more than the neutral stimuli. There was no significant interaction between groups and picture types. With regard to the direction of the initial EM, smokers were more likely than chance to look initially at aversive pictures. However, nonsmokers did not indicate a significant bias on this measure, and there was no significant difference between the two groups. These results offer some support for our hypothesis and the preceding study (Mogg et al., 2003). Although not significant, smokers tended to have more initial fixation on smoking-related pictures than nonsmokers did.

In the current study, smokers gazed at smoking-related pictures longer than nonsmokers did. Mogg et al.'s (2003) study analyzed the duration time of initial fixation but found no significant difference on smoking-related cues between smokers and nonsmokers. In another study, deprived smokers gazed at smoking-related pictures longer than when in their normal (nondeprived) state (Field, Mogg, & Bradley, 2003). There are no studies that have identified the different gaze duration between smokers and nonsmokers. In our study, we analyzed the overall gaze duration time and found that
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Smokers have a significant attentional bias toward smoking-related cues.

Another interesting finding is that both groups had the tendency to gaze longer at, and initially fixate on, aversive stimuli rather than other stimuli. Smokers and nonsmokers both indicated a significantly higher degree of initial fixation on aversive rather than neutral cues. There were no significant difference between groups on gaze duration, but both groups gazed at aversive stimuli longest. This does not support our hypothesis that only smokers would show attentional bias to aversive stimuli. We also hypothesized that different anxiety levels would lead to different attentional bias between groups. In the study of smoking deprivation, various withdrawal symptoms appear 6-12 hours after smoking cessation (Hughes, 1992). In the present study, the mean time of deprivation was 11.36 hours. According to Hughes, this deprivation time is sufficient for withdrawal symptoms to occur, but there was no significant difference in anxiety level between the two groups. In future studies, the anxiety level should be determined before the experiment. Attentional bias to aversive stimuli could be accounted for by the characteristic of emotional stimuli. Previous studies have found that younger adults detect threatening stimuli more quickly than other types of stimuli (Vuilleumier, 2002). Stimuli with emotional valence tend to attract attention more than neutral stimuli. It seems that the emotional valence of aversive stimuli is higher than craving. The results suggest it is necessary to control the emotional valence of stimuli.

In a previous study, researchers identified additional information (pupil dilation and the number of eye blinks) when paying attention (Anita, Chantal, & Sandra, 2005). When attending to specific stimuli, participants’ pupils dilated and the number of eye blinks decreased. Measuring not only the initial fixation and gaze duration in eye movement, but also the pupil size and number of eye blinks could provide a useful indicator of attentional bias.

In conclusion, smokers gazed at smoking-related pictures longer than nonsmokers did, but there was no difference in initial fixation. Gaze duration could therefore be a sensitive measurement tool for identifying attentional bias.

Reference


**CONTACT**

Jang-Han Lee, Ph.D.
Assistant Professor
Clinical Neuro-psychology Lab
Department of Psychology
Chung-Ang University
221, Heukseok-dong
Dongjak-gu, Seoul 156-756, Korea
Tel: +82-2-820-5751
Fax: +82-2-816-5124
E-mail: clipsy@cau.ac.kr