

## Differences of Photographs Inducing Craving Between Alcoholics and Non-alcoholics

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Many researchers have used cue reactivity paradigm to study alcohol craving. But the difference of craving response to drinks between alcoholic patients and social drinkers was little evaluated. To investigate characteristics of alcohol-related visual cues which induce alcohol craving in alcoholism, we examined the response of subjects to alcohol-related cues considering qualitative aspects. The authors developed 27 photographs related to alcohol as candidate visual cues. Thirty five patients with alcohol dependence, 35 heavy drinkers and 35 social drinkers were shown these pictures and asked to rate these 6 pictures in order of inducing alcohol craving the most. 'A glass of Soju' and 'A Party scene' were chosen as the alcohol-related visual cues which induced craving the most in the patients and heavy drinkers, respectively. The results suggest that the patients with alcohol dependence are more absorbed by alcohol without drinking context such as an atmosphere or situation involving drinking. Heavy drinkers may experience craving in anticipation of being in a drinking situation.

**Key Words:** Alcoholism, alcohol craving, alcohol cues

### INTRODUCTION

There have been many studies to understand neurobiological correlates of craving for alcohol.<sup>1-4</sup> Researchers and clinicians consider craving for alcohol a precursor of relapse in alcohol dependent patients.<sup>5-7</sup> Therefore, understanding the mechanisms of alcohol craving is important to understand alcohol dependence and to provide

treatment and prevention.

Alcohol craving can be triggered by exposure to an object, environment, or emotion that a person has come to associate with alcohol consumption. To investigate the craving, many researchers have used the cue-reactivity paradigm.<sup>8-11</sup> Most of recent studies in functional neuroimaging about alcohol craving have used cue-reactivity paradigm: especially visual cues because of their simplicity and handiness.<sup>1-3,11</sup> The pictures as craving-inducing visual cues are variable from advertisements to still-photos of alcoholic beverage.

There are some differences between individuals reporting alcohol craving in response to alcohol-related cues. It is partially attributable to the differences between the viewpoints of craving mechanism. Ludwig and colleagues<sup>12</sup> suggested that the craving elicited by alcohol-related cues could be acquired through a learning process called classical conditioning. On the other hand, Drummond and colleagues<sup>13</sup> argued cognitive learning theory and information processing theory may better account for the results of cue-reactivity studies than classical conditioning theory. This gap of the viewpoints might be dependent on whether subjects are alcoholic patients or not. To explore discriminating characteristics of visual cues inducing alcohol craving in alcohol dependence is very helpful for developing reliable and valid stimuli of functional imaging studies which are important for understanding the mechanisms of craving in alcohol dependence.

The primary objective of this study was to develop alcohol-related visual cues which reliably induce the urge to drink alcohol in alcohol dependence. The secondary objective was to examine

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differences in cue response among alcohol dependent group, heavy drinking group, and social drinking group.

## MATERIALS AND METHODS

### Subjects

The subjects were aged from 19 to 50 years and educated for 12 years or more. Patients with alcohol dependence were recruited from the detoxification unit at Severance Mental Health Hospital, Yonsei University College of Medicine, Korea. They fulfilled the DSM-IV criteria<sup>14</sup> for alcohol dependence and were abstinent for at least two weeks before the study. Heavy drinkers and social drinkers matching their age, sex, and education to those of the patients were recruited from the community through newspaper advertisements. Heavy drinkers were defined as subjects who drank more than 14 standard drinks per week or 4 drinks per occasion in males, over 7 drinks per week or 3 drinks per occasion in females,<sup>15</sup> and did not meet the DSM-IV criteria for alcohol use disorder. Social drinkers included subjects who drank less than 14 drinks per week and 4 drinks per occasion in males, less than 7 drinks per week and 3 drinks per occasion in females, and who did not meet the DSM-IV criteria for alcohol use disorder.

Written informed consent was obtained from all subjects. Exclusion criteria were meeting the DSM-IV criteria for any other substance use disorder except caffeine or nicotine, any other axis I disorder, and any visual or hearing impairment. Our study was carried out under the guidelines for the use of human subjects established by the institutional review board at Severance Mental Health Hospital. The sociodemographic and clinical characteristics of the subjects are given in Table 1.

### Development of candidate pictures

Twenty-seven color photographs of stationary objects and situations involving alcohol drinking were developed. These pictures consisted of three sets of alcoholic beverages: Soju, beer and whisky. Soju is the most popular traditional liquor in Korea. It is a strong spirit distilled from sweet potato, clear like vodka, and 21-25% of alcoholic concentration (Korea Alcohol and Liquor Industry Association, 2002). Each set included seven pictures of 1) a glass filled with alcoholic beverage, 2) a bottle, 3) a glass and a bottle, 4) a glass, a bottle and a side dish, 5) a scene showing glasses being poured, 6) someone drinking, and 7) an advertisement, for each of three kinds of alcohol beverages. Also included in each set were two pictures of a party scene, a signboard of a bar, and alcoholic beverages

**Table 1.** Sociodemographic and Clinical Characteristics

	Alcohol dependence (n = 35)	Heavy drinkers (n = 35)	Social drinkers (n = 35)	F/ $\chi^2$	p value
Gender (M/F)	29/6	29/6	29/6	0	1.0
Age (years)	38.5 $\pm$ 6.9	38.3 $\pm$ 6.7	38.7 $\pm$ 7.1	0.03	0.967
Education (years)	13.6 $\pm$ 2.0	13.2 $\pm$ 1.9	13.7 $\pm$ 2.1	0.55	0.581
First drinking age (years)	19.1 $\pm$ 2.5	20.8 $\pm$ 3.7	20.6 $\pm$ 2.0	3.44	0.036 <sup>†</sup>
FHx of alcoholism (%)	57	40	11	16.17	0.000 <sup>‡</sup>
Solitary drinking habit (%)	86	3	3	75.60	0.000 <sup>‡</sup>

Data are mean  $\pm$  standard deviation.

<sup>†</sup> Significant difference between patients and social drinkers, and between patients and heavy drinkers.

<sup>‡</sup> Significant difference between patients and heavy drinkers, between patients and social drinkers, and between heavy drinkers and social drinkers.

FHx, family histories.

displayed in a liquor store. Candidate pictures were developed taking into consideration the level of complexity of the stimuli.

Stationary object pictures were taken at a distance of 30 cm from and at an angle of 45 degrees above the objects, so that the pictures could simulate views that people sitting at a table would ordinarily see. In case of the situational pictures, the objects were photographed so as to produce sizes and lengths of objects that could simulate actual drinking scenes. Using a SONY Cyber-shot DSC-F505V digital camera, the pictures were taken with a resolution of 3.3 Mega Pixels and printed using a color printer with a size of 18 × 25 cm. The pictures were then vinyl coated.

### Procedure

Each candidate picture was presented to the subjects in random order for 5 seconds between 10 am and 11 am. To explore common characteristics of craving-inducing stimuli and to avoid denying or underreporting the craving, we used ranking procedure. The subjects were instructed to focus on the pictures and to choose the 6 pictures that made them crave for alcohol the most. Each picture was counted how many subjects in each group chose it to make them crave for alcohol the most. For the picture that induced alcohol craving the most, the subjects were asked to describe the reason for this being the case. The picture that induced alcohol craving the most was ranked 1st, followed by the 2nd, 3rd, 4th, 5th and 6th ranks according to the severity of the craving. Unselected pictures were ranked 7th.

### Statistical analysis

The sociodemographic and clinical characteristics of the subjects were compared between the groups using one-way ANOVA or chi-square test. Each picture was compared for the count of being chosen to induce craving most among three groups by the Kruskal-Wallis one-way Analysis of Variance, and multiple comparisons were carried out using Tukey's test.

## RESULTS

### Sociodemographic characteristics

The first drinking age was significantly lower in the patients than in the heavy drinkers and the social drinkers ( $F = 3.44$ ,  $df = 2$ ,  $p = 0.036$ ). A family history of alcohol dependence was also more frequently found in the patients and the heavy drinkers than in the social drinkers ( $\chi^2 = 16.17$ ,  $df = 2$ ,  $p < 0.001$ ). Solitary drinking habit was more frequently found in the patient group than in the heavy drinkers and the social drinkers ( $\chi^2 = 75.60$ ,  $df = 2$ ,  $p < 0.001$ ).

### Alcohol-related visual cues inducing the most craving in each group

'A glass of Soju' (mean rank = 3.89), 'pouring Soju' (mean rank = 4.20), 'a glass and a bottle of Soju' (mean rank = 4.80), 'a bottle of Soju' (mean rank = 5.31), and 'drinking Soju' (mean rank = 6.09) were chosen as the pictures inducing craving the most in the patients with alcohol dependence. All of these pictures were significantly more selected by the patients than by other two groups ( $p < 0.05$ ).

In the case of the heavy drinkers, 'party scene II: toast!' (mean rank = 3.17), 'a glass and a bottle of Soju with side dishes' (mean rank = 4.09), 'party scene I: pouring' (mean rank = 4.94), 'a glass and a bottle of beer with side dishes' (mean rank = 5.43) were selected as the most craving-inducing pictures. Among them, 'party scene II: toast!' (mean rank = 3.17) and 'party scene I: pouring' were significantly more chosen by the heavy drinkers than by other two groups' ones ( $p < 0.05$ ).

Comparing to them, in the case of the social drinkers, 'a glass and a bottle of Soju with side dishes' (mean rank = 4.77), 'a glass and a bottle of beer with side dishes' (mean rank = 4.83), 'a glass and a bottle of whisky with side dishes' (mean rank = 5.00), 'a glass of beer' (mean rank = 5.66), and 'an advertisement of beer' (mean rank = 5.77) were selected as visual cues inducing craving the most. Among them, 'a glass and a bottle of whisky with side dishes' were significantly more selected in social drinkers than in other two groups ( $p < 0.05$ ; Table 2 and Fig. 1). Comparison of the al-



Fig. 1. Alcohol-related visual stimuli inducing craving the most in each group.

cohol-related cues inducing the strongest craving between the three groups is shown in Table 2.

## DISCUSSION

In this study, we found that alcohol-related cues as inducing craving, selected by the patients with alcohol dependence, was different from those selected by controls. The patients of alcohol dependence felt alcohol craving not by looking complex pictures or pictures of drinking situation, but by looking simple pictures like as 'a glass of Soju' or 'pouring Soju'. They seemed to be more absorbed in alcohol itself. The responses of the

patients were as follows; "I don't even like the hand covering the glass, I only care for alcohol itself.", "I feel more like having a drink when I see the bottle without any side dishes." It seems that alcohol itself played an important role in inducing alcohol craving in alcohol dependence. Most of them could not describe the exact reason why they felt craving by alcohol itself but answered "I just feel like drinking." This suggests that the craving in alcohol dependence might be a fundamental motivation, which is close to a conditioned reflex. It may be associated with the finding that solitary drinking habit was more frequent in the patients than in the heavy drinkers and the social drinkers. Through repeated consumption of al-

**Table 2.** Comparison of Ranks of Alcohol-Related Visual Stimuli

No.	Visual stimuli	Mean Rank			$\chi^2$ *	df	p value
		Alcohol dependence	Heavy drinkers	Social drinkers			
1	A glass of Soju	3.89 <sup>†</sup>	6.83	6.77	43.90	2	0.000
2	Pouring Soju	4.20 <sup>†</sup>	6.31	6.63	28.26	2	0.000
3	A glass and A bottle of Soju	4.80 <sup>†</sup>	6.77	7.00	32.11	2	0.000
4	A bottle of Soju	5.31 <sup>†</sup>	6.91	7.00	30.91	2	0.000
5	Drinking Soju	6.09 <sup>†</sup>	6.89	7.00	18.09	2	0.000
6	The party scene II (Toast!)	5.43	3.17 <sup>†</sup>	5.86	22.02	2	0.000
7	A glass & a bottle of Soju/a side dish	6.49	4.09 <sup>‡</sup>	4.77 <sup>‡</sup>	18.53	2	0.000
8	The party scene I (pouring)	6.09	4.94 <sup>†</sup>	6.43	12.23	2	0.002
9	A glass & a bottle of beer/a side dish	6.70	5.43 <sup>‡</sup>	4.83 <sup>‡</sup>	24.62	2	0.000
10	A glass & a bottle of whisky/a side dish	6.83	6.40	5.00 <sup>†</sup>	25.22	2	0.000
11	A glass of beer	6.03	6.71	5.66 <sup>§</sup>	13.88	2	0.001
12	An advertisement for beer	6.63	5.83 <sup>‡</sup>	5.77 <sup>‡</sup>	7.95	2	0.019
13	A glass of whisky	6.86	6.94	7.00	2.04	2	0.361
14	A bottle of beer	6.69	6.89	6.71	0.31	2	0.857
15	A bottle of whisky	6.97	6.91	6.26	3.88	2	0.144
16	A glass and a bottle of beer	6.69	6.09	5.77	5.45	2	0.066
17	A glass and a bottle of whisky	6.91	6.40	5.00	1.18	2	0.556
18	Pouring beer	5.97	5.86	6.34	1.01	2	0.604
19	Pouring whisky	6.60	6.51	6.37	0.93	2	0.630
20	Drinking beer	6.71	6.71	6.69	0.40	2	0.821
21	Drinking whisky	6.83	6.83	7.00	2.88	2	0.237
22	Alcohol & other drinks in a refrigerator	6.63	6.40	6.11	2.37	2	0.306
23	The alcoholic drinks stand	5.74	5.20	5.09	1.60	2	0.448
24	A sign board of Soju bar	6.63	6.37	6.26	2.43	2	0.296
25	A sign board of beer bar	6.69	6.63	6.49	0.21	2	0.903
26	An advertisement for Soju	6.80	6.86	6.69	0.25	2	0.885
27	An advertisement for whisky	6.66	6.54	5.86	5.90	2	0.052

\*Kruskal-Wallis test.

<sup>†</sup>Inducing significantly more craving than other groups.<sup>‡</sup>Inducing significantly more craving in heavy drinkers and control group than alcoholics.<sup>§</sup>Inducing significantly more craving in control group than heavy drinkers.

cohol, alcohol itself activates thoughts about alcohol automatically. Several studies supported

that expectancy for alcohol in alcohol dependence can be activated implicitly and automatically

without using attentional resources.<sup>16,17</sup> The patients might drink not expecting the effects of alcohol (e.g. relaxation) or friends, or drinking situation. These are too trivial for the patients, and only alcohol itself can draw attention of them.

However, unlike the patients, heavy drinkers selected the pictures of a drinking situation such as 'the party scene (toast scene)'. They felt the most craving not looking at still life pictures of an alcoholic beverage but looking at the pictures of people getting together and drinking. They explained the reason for the choice as follows: "The atmosphere seems friendly. Drinking together would make me feel good."; "It makes me feel like drinking together with close friends." Their responses demonstrated that it was their expectation of a drinking atmosphere for heavy drinkers to stimulate the craving for alcohol rather than the alcohol itself. It suggests that alcohol craving in heavy drinkers might be due to positive expectation of drinking.

There were no consistent characteristics in the alcoholic cues inducing craving in social drinkers. Someone reported "The sole alcoholic beverage didn't induce craving." Another social drinker said "The side dishes seem to suit with that liquor." By chance, side dishes were included in top three pictures that were selected by them. It may be related to usual drinking situations of social drinkers. It suggests that appetite might be expressed as if it were alcohol craving.

Our finding corresponds to the conclusion of previous studies,<sup>18,19</sup> which indicated that positive outcome expectancy plays a major role in the cue-elicited alcohol craving of social drinkers, especially in the heavy drinker group. Accordingly, cue-elicited alcohol craving in heavy drinkers might originate from a positive expectation of alcoholic effects and alcohol-related memory through higher cognitive processing performed by the prefrontal cortex.<sup>20</sup> It is noticeably different from the finding that the patients of alcohol dependence reported craving in negative mood states, such as depression, anger, or interpersonal stress.<sup>7</sup>

Seeing that many alcoholics have become dependent by way of heavy drinking, it seems that craving in the early phase of alcohol dependence may arise from cognitive processing of the

higher cortical function. As the severity of the illness becomes worse, craving might arise through an automatic process not needing cognitive investment.

One limitation of this study is that the number of subjects is too small to maintain the statistical power. And the subject may not be representative of alcohol dependence in general because all patients were hospitalized, who might have more severe problems of the illness.<sup>21</sup> It would have been necessary to include more patients with wide range of severity. Another limitation of this study is that the evaluation of alcohol craving was based on subjective report, which may raise doubts about the reliability of the results.<sup>22,23</sup> Therefore, it is necessary to use more objective method together for measuring the craving. However, these cannot be also considered to constitute a reliable index of craving because of variability of the physiological responses.<sup>22</sup>

In summary, we developed a series of pictures as alcohol-related visual cues that induce the craving in alcohol dependence and heavy drinkers. Our results indicate that alcohol dependence feel the craving the most by alcohol itself, whereas heavy drinkers do by a drinking atmosphere. It suggests that cue-elicited alcohol craving in alcohol dependence may result from automatic reflex, while the same effect may result from a cognitive processing in heavy drinkers.

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