Application of **Virtual Reality-Cue Exposure Therapy** for Reducing Alcohol Craving

Hyoseok Kwon, B.A., Jang-Han Lee, Ph.D.
Department of Psychology, Chung-Ang University

Sungwon Roh, M.D., Ph.D., Joonho Choi, M.D., Ph.D., Byung-Hwan Yang M.D.,Ph.D.
Department of Neuropsychiatry, Hanyang University

---

**Introduction**

**Cue-reactivity**

A classical conditioned response pattern that occurs when an addicted subject is exposed to drug-related stimuli.

**Cue-exposure therapy (CET)**

**Subjective cue-elicited reactions**

- Craving
- Withdrawal symptoms
- Drug-agonistic effects
- Mood swings

**Physiological reactions**

- Skin conductance
- Heart rate
- Salivation
- Body temperature
- Brain activity

**Relapse**
Clinical Neuro Psychology Lab. Department of Psychology, Chung-Ang University

The formation of craving and the mechanism of CET explained by classical conditioning

- Unconditioned Stimuli repeatedly paired with Unconditioned Response
- Conditioned Stimuli paired with Conditioned Response

Introduction

Limitations of previous CET studies:
- Extinction in a hospital or office, which is not the place where alcoholics drink.
- Using only one or two cues

Advantages of using a virtual reality in CET:
- Treatment in diverse stimuli and places
- Extinction in a bar which alcoholics strongly feel cravings for alcohol
- Being safer than in vivo-cue exposure therapy
- Superior controllability
### Introduction

**Results of classical CET**

<table>
<thead>
<tr>
<th>Study</th>
<th>Drug</th>
<th>Therapy</th>
<th>session</th>
<th>Cue Length</th>
<th>Cue</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corty &amp; McFall (1984)</td>
<td>nicotine</td>
<td>individual</td>
<td>8</td>
<td>A</td>
<td>-</td>
<td>-0.4500</td>
</tr>
<tr>
<td>Childress et al. (1987)</td>
<td>Cocaine/opiate</td>
<td>group</td>
<td>20</td>
<td>60</td>
<td>A,V,IV</td>
<td>-</td>
</tr>
<tr>
<td>Dawe et al. (1993)</td>
<td>opiate</td>
<td>individual</td>
<td>6</td>
<td>41-80</td>
<td>P,V,IV</td>
<td>+0.8005</td>
</tr>
<tr>
<td>Drummond &amp; Glaunier (1994)</td>
<td>alcohol</td>
<td>individual</td>
<td>10</td>
<td>50</td>
<td>IV</td>
<td>+0.17-3</td>
</tr>
<tr>
<td>Franken et al. (1999)</td>
<td>opiate</td>
<td>individual</td>
<td>9</td>
<td>45-50</td>
<td>P,V,IV</td>
<td>-</td>
</tr>
<tr>
<td>Gotestam &amp; Melin (1983)</td>
<td>nicotine</td>
<td>individual</td>
<td>6</td>
<td>-</td>
<td>I</td>
<td>-</td>
</tr>
<tr>
<td>Kasvikis et al. (1991)</td>
<td>opiate</td>
<td>individual</td>
<td>14</td>
<td>45</td>
<td>P,IV</td>
<td>-</td>
</tr>
<tr>
<td>Lowe et al. (1980)</td>
<td>nicotine</td>
<td>group</td>
<td>8</td>
<td>Variable</td>
<td>IV</td>
<td>-0.5180</td>
</tr>
<tr>
<td>Mclellan et al. (1986)</td>
<td>opiate</td>
<td>individual</td>
<td>35</td>
<td>10-15</td>
<td>P,A,V,I,IV</td>
<td>-</td>
</tr>
<tr>
<td>Mont et al. (1993)</td>
<td>alcohol</td>
<td>individual</td>
<td>6</td>
<td>55</td>
<td>I,IV</td>
<td>+0.7345</td>
</tr>
<tr>
<td>Niaura et al. (1999)</td>
<td>nicotine</td>
<td>individual</td>
<td>5</td>
<td>75-90</td>
<td>I,IV</td>
<td>-0.2029</td>
</tr>
<tr>
<td>O’Brien et al. (1990)</td>
<td>Cocaine</td>
<td>individual</td>
<td>15</td>
<td>60</td>
<td>A,V,IV</td>
<td>-</td>
</tr>
<tr>
<td>O’Brien et al. (1979)</td>
<td>opiate</td>
<td>individual</td>
<td>18</td>
<td>60</td>
<td>IV</td>
<td>-</td>
</tr>
<tr>
<td>Powell et al. (1993)</td>
<td>opiate</td>
<td>individual</td>
<td>2</td>
<td>45-50</td>
<td>P,IV</td>
<td>-</td>
</tr>
<tr>
<td>Rankin et al. (1983)</td>
<td>alcohol</td>
<td>individual</td>
<td>12</td>
<td>65</td>
<td>I,IV</td>
<td>-</td>
</tr>
<tr>
<td>Raw &amp; Russell (1980)</td>
<td>nicotine</td>
<td>group</td>
<td>7</td>
<td>45</td>
<td>IV</td>
<td>-0.0251</td>
</tr>
<tr>
<td>Rohsenow et al. (2000)</td>
<td>alcohol</td>
<td>individual</td>
<td>10</td>
<td>50</td>
<td>I,IV</td>
<td>+0.5420</td>
</tr>
<tr>
<td>Sitharthan et al. (1997)</td>
<td>alcohol</td>
<td>group</td>
<td>6</td>
<td>50</td>
<td>IV</td>
<td>+0.6070</td>
</tr>
</tbody>
</table>

**Clinical Neuro pSychology Lab. Department of Psychology, Chung-Ang University**

---

### Introduction

**VR-based cue-exposure studies**


**Clinical Neuro pSychology Lab. Department of Psychology, Chung-Ang University**

---

3
Introduction

- Study’s Aims:
  - To investigate which objects and places are most likely to elicit craving for alcohol
  - To verify whether VR-CET has an effect on desensitization to alcohol cues

Method

- Preliminary survey and composition of cues and scenarios

Survey participants:
- **Ward group**: 49 alcohol dependence inpatients (diagnosed with DSM-IV)
- **AA group**: 35 members in the Alcohol Anonymous group
- **Normal group**: 63 light drinkers

*No significant difference in age between groups*
Method

- The open-ended questions:
  1) which places elicited a craving to drink
  2) which objects elicited a craving to drink
  3) which place or object was most likely to induce cravings
* From the results of this survey, VR-CET scenarios are created.

- Two types of virtual environment

---

Clinical Neuro pSychology Lab. Department of Psychology, Chung-Ang University
Method

**Experiment**

*Participants:*
- 8 people (hospitalized more than once for alcohol treatment) from AA group underwent total 8 group sessions of VR-CET mean age’s 50.5 years (SD = 14).

- Average period of abstinence : 58.75 months (SD = 98.07)

- In the past, drinking 28 standard glasses of Soju* daily

*Soju is a type of alcohol in Korea, inexpensive, moderate-proof (21%), and very popular.*
**Method**

**Experiment**

*Measurement and VR instrument:*

1) Measuring the level of alcohol craving:
   - Penn Alcohol Craving Scale (PACS)
   - Alcohol Urge Questionnaire (AUQ)
   - Obsessive Compulsive Drinking Scale (OCDS)

2) VR instruments: Pentium IV PC, Open GL Accelerator VGA card, a beam projector with a $2.4m \times 1.8m$ screen, and surround speakers.

**Procedure**

- Introduction: 5min.
- Navigation & Interview: 20min.
- Questionnaire: 5min.

3 questionnaires

Measuring craving by AUQ
k1  5 items focuses on the urge that the participant felt to drink during the previous week, using a 7-point scale.
  ): 8 items about dependence on, and preoccupation with, alcohol, using a 7-point scale.
  ): 14 items quantify thoughts about alcohol and drinking behavior, using a 5-point scale.

kwon; 2006-01-30
Method

Themes of the CET Program Sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Theme</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initial navigation</td>
<td>The participant was free to navigate during the initial session.</td>
</tr>
<tr>
<td>2</td>
<td>Person-elicited craving</td>
<td>Interview with the participant about the person that elicits craving.</td>
</tr>
<tr>
<td>3</td>
<td>Object-elicited craving</td>
<td>Interview with the participant about the object that elicits craving.</td>
</tr>
<tr>
<td>4</td>
<td>Situation-elicited craving</td>
<td>Interview with the participant about the situation that elicits craving.</td>
</tr>
<tr>
<td>5</td>
<td>Person-elicited craving</td>
<td>Repeat the questions of 2nd session</td>
</tr>
<tr>
<td>6</td>
<td>Object-elicited craving</td>
<td>Repeat the questions of 3rd session</td>
</tr>
<tr>
<td>7</td>
<td>Situation-elicited craving</td>
<td>Repeat the questions of 4th session</td>
</tr>
<tr>
<td>8</td>
<td>Final navigation</td>
<td>The participant was free to navigate during the final session.</td>
</tr>
</tbody>
</table>

Result

Subjective Responses to CET

<table>
<thead>
<tr>
<th>Session</th>
<th>Interview responses to CET sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-elicited sessions</td>
<td>- If I drank with a woman, I would drink much more.</td>
</tr>
<tr>
<td></td>
<td>- I have never drank with a woman so that I really want to drink with a woman.</td>
</tr>
<tr>
<td>Object-focused sessions</td>
<td>- Soju bottle makes me crave more for drinking than a beer bottle.</td>
</tr>
<tr>
<td></td>
<td>- Only a bottle catches my eye in the screen.</td>
</tr>
<tr>
<td>Situation-focused sessions</td>
<td>- The Japanese bar makes me crave more for drinking than the western bar because of familiarity.</td>
</tr>
<tr>
<td></td>
<td>- The fact that alcoholics like drinking alone in their home was overlooked.</td>
</tr>
<tr>
<td>General comments</td>
<td>- Audio stimuli made me feel more realistic than visual stimuli.</td>
</tr>
<tr>
<td></td>
<td>- The scene, drinking alone, is more attractive.</td>
</tr>
<tr>
<td></td>
<td>- The more I was exposed to the stimuli, the less tension was produced.</td>
</tr>
</tbody>
</table>
**Result**

- No significant changes of urge and thought on OCDS ($F=1.436$) and PACS ($F=0.286$) after whole sessions.

- A slight reduction of craving between S. 1 and S. 8 on AUQ (also no statistically significant $F=2.222$)

- Strictly controlled, the interaction of the treatment and base line of craving level was observed. ($F=10.701$, $p<.05$)

**Discussion**

**The merits of this study**
- Experiences of desensitization to alcohol-related cues and environments.

- Offering more vivid experience by VR, cue-exposure therapy would be more effective.

**The limits of this study**
- Short periods of treatment
- Variation of participants
- Small samples
- Measure by Self-report
Additional report

fMRI study

MR-compatible experimental device

-Procedure-

Whole scan time = 267 sec, 94 scan, Dummy scan = 12 sec

Control images                   Pre-CET images              Post-CET images
Lt. thalamus                     Rt. cingulate gyrus          Rt. thalamus

The changes of brain activity after VR-CET

Control images                   Pre-CET images              Post-CET images
Lt. thalamus                     Rt. cingulate gyrus          Rt. thalamus
The End

Thank you for attention

fun2000@hanmail.net