



## Explicit and implicit heroin-related cognitions and heroin use among patients receiving methadone maintenance treatment

Peng-Wei Wang<sup>a,b</sup>, Huang-Chi Lin<sup>a,b</sup>, Hung-Chi Wu<sup>d</sup>, Chih-Yao Hsu<sup>d</sup>, Kuan-Sheng Chung<sup>d</sup>, Chih-Hung Ko<sup>a,b,c,\*,1</sup>, Cheng-Fang Yen<sup>a,b,\*,1</sup>

<sup>a</sup>Department of Psychiatry, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan

<sup>b</sup>Department of Psychiatry, Faculty of Medicine and Graduate Institute of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>c</sup>Department of Psychiatry, Kaohsiung Municipal Hsiao-Kang Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan

<sup>d</sup>Departments of Addiction Science, Kai-Suan Psychiatric Hospital, Kaohsiung, Taiwan

### Abstract

**Background:** Craving is an important issue in substance use disorder. To achieve a better understanding of the cognitive processing systems of craving, the cognitive processes of craving have been considered as two distinct processes. One system, based on rule-based inferences and named explicit cognition, is more conscious and effortful. The other system, based on prior learned association and named implicit cognition, is unconscious and effortless. How explicit and implicit cognitions are associated with heroin use in patients with methadone maintenance treatment (MMT) is not clear. This study aimed to explore the relationship between explicit and implicit cognition and heroin use in patients undergoing MMT.

**Method:** This study recruited one-hundred forty intravenous heroin users. The participants were invited to provide social–demographic data, the severity of substance dependence and explicit cognition with regard to heroin. Then, participants completed a computerized test to assess implicit cognition with regards to heroin.

**Results:** This study found that explicit and implicit heroin-related cognitions were associated with the frequency of heroin use. There was an interaction effect between implicit and explicit cognition on the frequency of heroin use. This study also found that higher explicit heroin-related cognition was a risk factor for continuing heroin use.

**Conclusion:** Both explicit and implicit cognitions were associated with the frequency of heroin use in patients undergoing MMT, but only explicit cognition was associated with whether patients could stop using heroin during MMT. Therefore, the status of heroin use in patients undergoing MMT may be related to different cognitive processes.

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### 1. Introduction

Craving is becoming more and more important in terms of conceptualizing and treating substance use disorder because it can destabilize patients seeking treatment for substance abuse [1] and has been used as a criterion of substance use disorder in the *DSM-5* [2]. To achieve a better understanding of the cognitive processing systems of craving involved in initiation and escalation of substance use, scholars have

considered the cognitive processes of craving as two distinct processes [3–5]. One system, based on rule-based inferences and named explicit cognition, enables quickly learning the representation of unique or novel event and is more conscious and effortful. The other system, based on prior learned association and named implicit cognition, enables slow learning of general regularities and is unconscious as well as effortless.

A meta-analysis study by Rooke and colleagues showed that implicit substance-related cognition is significantly associated with substance use [6]. Research has also found that explicit heroin-related cognition may be associated with illicit heroin use in patients receiving methadone maintenance treatment (MMT) [7]. Furthermore, a previous study on former heroin users demonstrated that the level of explicit heroin-related cognition did not increase after exposure to

\* Corresponding authors at: Department of Psychiatry, Kaohsiung Medical University Hospital, 100 Tzyou 1st Road, Kaohsiung 807, Taiwan. Tel.: +886 7 312 4941; fax: +886 7 3134761.

E-mail address: [chfaye@cc.kmu.edu.tw](mailto:chfaye@cc.kmu.edu.tw) (C.-F. Yen).

<sup>1</sup> Cheng-Fang Yen, MD., PhD and Chih-Hung Ko, MD., PhD contributed equally to the work.

heroin-related and neutral cues, but the blood oxygen-level dependence intensity on MRI increased when the participants were exposed to heroin-related, not neutral, cues [8]. The results of previous studies imply that not only explicit heroin-related cognition but also implicit cognition may play a role in heroin-related craving in heroin users.

Heroin use is an important clinical issue because heroin users usually suffer from a chronic relapsing course, as well as a lots of adverse social and health consequences, criminal activities, reliance on social services, and blood-borne infections [9,10]. MMT can improve heroin users' quality of life [11] and reduce their criminal activities [12]. However, although MMT can reduce the severity and frequency of heroin use, 30 to 70% of heroin users receiving MMT still cannot stop using heroin [13–16]. Because of the significant associations of both explicit and implicit cognitions with substance use found in previous studies [6,7,17], further study of the relationship of explicit and implicit cognition with continuous heroin use among heroin users receiving MMT is important. This study aimed to explore the relationships of explicit and implicit heroin-related cognitions with continuous heroin use and without heroin use among heroin users receiving MMT in Taiwan. We also explored whether the interaction between explicit and implicit cognition is associated with current heroin use and abstinence of heroin. We hypothesized that among heroin users receiving MMT: (a) explicit and implicit heroin-related cognitions that are unfavorable to heroin use are associated with whether patients can keep abstinence of heroin or not; (b) explicit and implicit unfavorable heroin-related attitudes may interact with each other in terms of their relationship with abstinence from heroin use; (c) explicit and implicit heroin related cognitions that are unfavorable to heroin use are associated with frequency of current heroin use in patients with MMT and continuing heroin use; (d) the relationships of explicit and implicit unfavorable heroin-related cognitions with frequency of heroin use may interact with each other in the continuing heroin use group.

## 2. Methods

### 2.1. Participants

This study recruited intravenous heroin users who visited the MMT clinics of Kaohsiung Medical University Hospital and Kai-Suan Psychiatric Hospital. All were opioid-dependent: psychiatrists conducted a diagnostic interview based on the Structured Clinical Interview for *DSM-IV* for Axis I Disorders (SCID) to determine the diagnosis of heroin dependence. They also must have been taking a stable dosage of methadone for more than 1 month. Heroin users who conformed to the criteria described above were recruited into this study. The Institutional Review Board of Kaohsiung Medical University and Kai-Suan Psychiatric Hospital approved the study protocol.

### 2.2. Measures

#### 2.2.1. Socio-demographic characteristics

Participants' sex, age and age of initial heroin use were recorded.

#### 2.2.2. The Chinese version of the Severity of Dependence Scale (SDS<sup>[Ch]</sup>)

The 5-item SDS<sup>[Ch]</sup> was used to evaluate participants' severity of heroin dependence [18,19]. Each item is scored on a four-point scale (scored 0 to 3). The total SDS score ranges from 0 to 15, higher scores indicating a greater degree of dependence. Cronbach's  $\alpha$  of the SDS<sup>[Ch]</sup> in this study was 0.78.

#### 2.2.3. Visual Analogue Scale (VAS)

This study used a VAS with scores from 0 to 100 (none to very much) to measure explicit heroin-related cognition. The VAS includes the following question modified from Cullbertson et al. [20] and Sinha et al. [21]: "How much do you crave/desire/want heroin right now?"

#### 2.2.4. The Computerized Implicit Association Test (IAT) for heroin cues

In presenting the IAT to the participants, we closely followed the procedure described by Greenwald [22]. The target discrimination is heroin-related cues vs. neutral cues, and the attribute discrimination is pleasure vs. aversion. We used liked vs. disliked as attribute labels because these categories are strongly associated with inner motivation. The stimulus material consisted of 6 heroin-related cues (pictures) and 6 neutral cues (pictures) as well as 6 liked (e.g., "lucky, relaxed, pleasure, beauty, active, optimistic") and 6 disliked words (e.g., "doom, stress, depression, ugly, passive, pessimistic"). Phase 1 consisted of 24 trials in which heroin-related and neutral pictures were presented. During phase 2, liked and disliked words were presented in 24 trials. Phase 3 consisted of two blocks of 48 trials, during which each word or picture was presented twice. The liked word and heroin-related pictures were classified to the left side in the 48 trials. Phase 4 was identical to 2, except that the heroin-related pictures were classified to the right side and neutral pictures were classified to the left side. Phase 5 consisted of two blocks of 48 trials, during which each word or picture was presented twice. The liked words and neutral pictures were classified to the left side in the 48 trials. The IAT score was calculated as the difference in score between the mean response times of the heroin-liked/neutral-disliked block and the neutral-liked/heroin-disliked block, with larger scores indicating stronger automatic approach motivation toward heroin. The IAT score was calculated according to the D-measure algorithm suggested by Greenwald [23].

#### 2.2.5. Heroin use and methadone treatment characteristics

The current dosage of methadone, result of morphine urine examination and self-reported heroin use were recorded. Those who have abstained and did not abstain from heroin use during MMT were classified as the abstinent

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