Drug Cue Reactivity

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Drug cue reactivity is a type of learned response which is observed in individuals with drug addiction and involves significant physiological and subjective reactions to presentations of drug-related stimuli.

Keywords: cue reactivity ; cue exposure ; methamphetamine

1. Introduction

Several theoretical models of drug-use behaviors, such as the expectancy model, the dual-affect model, and the cognitive processing models have proposed that external environmental cues can serve as triggers for drug use [1][2]. Cues can produce symptoms of withdrawal in drug users, even after abstinence or detoxification [3][4]. A vast amount of empirical research has demonstrated that stimuli associated with the drug or its administration (e.g., bottle of preferred alcohol, syringe, lighter) can elicit subjective reports of craving and patterns of physiological responding in persons who have a history of drug use [5]. This phenomenon is often referred to as cue reactivity [5].

Drug cue reactivity is one of the hallmark characteristics in addiction research and numerous attempts have been made to elucidate the underlying learning mechanisms [5]. Drug cue reactivity was earlier proposed to be attributed to the formation of a direct association between the stimulus (i.e., the cue) and the response [6] but later theories began to support the view that drug cues elicit expectations of the drug, which drive drug-seeking behaviors [7]. With repeated drug experience, the drug user associates the rewarding effects of a drug with cues present at the time of consumption and this is known as classical conditioning, or Pavlovian conditioning [8]. In other words, formation of associations between cues and drugs is largely based on the premise of classical conditioning, during which initially neutral cues that are repeatedly paired with drugs (the unconditioned stimulus) acquire conditioned incentive properties and become the conditioned stimuli [7][9]. It is therefore through these Pavlovian associations that innocuous environmental stimuli become salient mediators of drug-seeking behaviors.

Cue reactivity paradigm is a valuable and versatile tool that aids the studying of cue-elicited drug craving. It typically involves the exposure of current or abstinent drug users to visual and/or auditory drug-related cues in order to monitor their reactions to these cues [10]. Exposure to drug-associated cues in laboratory settings has been shown to reliably induce drug craving and physiological reactions amongst drug users [5]. Such cue paradigms have been widely employed in addiction research across individuals who are addicted to various drugs including methamphetamine, heroin, cocaine and alcohol [5][10]. Furthermore, the application of cue reactivity paradigm has been examined in addiction research and cue reactivity studies have been proposed to offer insights into understanding the nature of drug dependence; predicting relapse and as a method of evaluating treatment efficacy [10][11][12].

2. Cue Reactivity to Methamphetamine

It is evident that methamphetamine-related cues can result in significant impact associated with exposure to these cues among methamphetamine users. These include an increase in subjective craving, physiological responses, activity in specific brain regions, as well as cognitive impairment. For example, methamphetamine stimuli are generally reported to increase levels of drug craving, “anxious” mood, and other physiological arousals such as heart rate, blood pressure, and skin conductance variability [13]. Blood-oxygen-level-dependent measures of methamphetamine cue reactivity revealed activation of a broad set of regions, particularly the mesocorticolimbic system which includes the ventral and dorsal striatum, the cingulate cortex, prefrontal cortex, and insula [14][15][16][17]. The exposure of methamphetamine-related cues has also been found to impair participants’ performances (increased rates of both response errors and inhibition errors) on an auditory dual-task Go–No Go cognitive test requiring divided attention and inhibition of distracting information [18].

3. Conclusions

Cue reactivity studies have been shown to be useful for understanding how craving would lead to continued drug-seeking behaviors and relapse among abusers in a real-life environment. Exposure to drug-associated cues can significantly induce measurable craving or other autonomic reactivity in laboratory settings. The use of cue reactivity paradigms also has important implications for the development of new pharmacological and psychosocial interventions for drug relapse prevention. Further studies on cue-induced craving are necessary to explore the effects that this notion could bring to treatment approaches.

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