Background

Drug addiction is a common problem in this country, especially for adolescents. The detrimental effects of exposure to addictive drugs during adolescence continue to affect individuals throughout their lifetimes (Yucel, Lubman, Solowlj & Brewer, 2007). Understanding the nature of drug addiction and dependence requires us to refine measures of emotional states and use these measures to examine the relationship between drugs and emotions.

When one is anxious, perhaps while watching a scary movie, one is startled more easily by loud noises than when in a more relaxed state. Likewise, previous research has shown that the acoustic startle reflex (ASR, a defensive reflex elicited by loud, sudden noise) is increased when humans or rats are presented with a tone that has previously been paired with shock (Lang, Bradley & Cuthbert, 1990; Davis, Falls, Campeau, & Kim, 1993). Another commonly found, acutely anxious state can be observed during withdrawal from drugs, particularly opiates. The ASR is potentiated during drug withdrawal in rats (Harris & Gewirtz, 2004).

Just as the ASR is increased during negative emotional states, it can be decreased (attenuated) during positive emotional states. One way this has been shown is by pairing certain odors with pleasurable stimuli, such as sweet food. These recent findings indicate a significant decrease in ASR for rats trained to associate odor with rewards (Schneider and Spanagel, 2008). Researchers have already tested whether odor can become associated with the positive effects of opiates. They have found that rats can experience morphine-like analgesia from exposure to odors previously paired with morphine (Valone, Randall, Kraemer, Bardo, 1998). For my UROP project, I will examine how
cues related to drug-taking affect emotional state by studying whether or not the ASR will attenuate when rats are presented with an odor that has previously been paired with morphine.

Method

The experiment starts with Phase 1, where the unconditioned effects of odor on startle are tested. For the first two days of the experiment, rats will be weighed and placed in testing chambers where they will experience 40 95- or 105-decible startles, 30 seconds apart to assess their regular ASR. Startle amplitude is measured by an accelerometer, interfaced with a computer that calculates the displacement of the chamber by the animal when it startles. On the third day, rats will be placed in the startle equipment as on the first two days, but midway through the startle session, a vial with ventilation holes filled with gauze soaked in either an odor such as lemon extract, or propylene glycol as a non-odor control, will be placed in the startle chamber near the rat. Several odors will be tested in this way to find odors that do not have an unconditioned effect on startle. Preliminary data I have collected from 3 rats in each group suggests that lemon extract may be an appropriate odor to use for the study, because it does not appear to change startle amplitude relative to baseline or non-odor control. On the other hand, vanilla odor may increase startle. More animals will be tested to clarify these results.

In Phase 2 of the experiment, the effect on startle amplitude of an odor previously paired morphine vs. that same odor paired with saline will be tested. On the first two days, new rats will be acclimated to the test procedure: each will be placed in a white box with a vial of propylene glycol. The rat will be injected with 1 ml/kg of saline and left in
the box for 30 minutes. On the third and fourth days, training will take place. Each rat will receive two trials per day (in one order on the first day and in the reverse order on the second day). One trial will pair the odor and drug: the rat will be placed in a white box with an odor-containing vial and injected with 10mg/kg of morphine, then left in the box for 30 minutes. The other trial will pair non-odor (propylene glycol) with a saline injection, so the rat will be placed in a white box with a non-odor-containing vial and injected with saline, then left in the box for 30 minutes. The fifth and sixth day will test the rats’ baseline startles, and the seventh day will be test day, in which the odor will be present in the chambers during startle testing. The hypothesis is that the animals’ ASR will attenuate in the presence of the odor.

**Broader Impacts**

The results of this study will be applicable in a variety of ways related to drug addiction and opiate withdrawal. It will help researchers and health care professionals better understand the role of cues to drug taking that may lead to relapse because of the association between the cue and the pleasurable feeling elicited by the drug. It could also be a stepping-stone to developing new ways to treat opiate addiction. One option would be to condition an association between the negative emotional state of withdrawal and the drug cue instead of the positive emotional state experienced when taking the drug. This research would also be very useful for my potential career working in child psychology. Because research has shown that the negative effects of opiate abuse are drastically increased and prolonged when drug use starts at an early age, this knowledge would be helpful in educating youth about the detrimental effects of drugs and could also function as a tool in helping those who have already begun to abuse drugs.