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Altered states: The impact of immediate craving on the valuation of current and future opioids☆

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Abstract

Based on prior research showing that people underestimate the influence of motivational states they are not currently experiencing, we predicted and found that heroin addicts would value an extra dose of the heroin substitute Buprenorphine more highly when they were currently craving (right before receiving BUP) than when they were currently satiated (right after receiving BUP)—even when the extra BUP was to be received 5 days later. If addicts cannot appreciate the intensity of craving when they are not currently experiencing it, as these results suggest, it seems unlikely that those who have never experienced craving could predict its motivational force. Under-appreciation of craving by non-addicts may contribute to initial decisions to experiment with drugs.

JEL classification: Addiction; Utility measurement

Keywords: Addiction; Craving; Behavioral economics; Hot-cold empathy gaps

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One of the central questions in the literature on drug abuse and addiction is why people take addictive drugs in the first place. As Goldstein (1994, p. 12) queries in his seminal book *Addiction*,

> "If you know that a certain addictive drug may give you temporary pleasure but will, in the long run, kill you, damage your health seriously, cause harm to others, and bring you into conflict with the law, the rational response would be to avoid that drug. Why then, do we have a drug addiction problem at all? In our information-rich society, no addict can claim ignorance of the consequences."

Several lines of research in economics have addressed this riddle. Perhaps most famously, Becker and Murphy (1988) argue that the addict's decision is, in fact, rational—based on an unbiased appraisal of alternative current and future options. Objecting to the implicit characterization of "happy addicts" in this perspective, Orphanides and Zervos (1995) modified the model to allow for uncertainty on the part of potential addicts about their own susceptibility to addiction. Although they assume that estimates are unbiased, on average, those who underestimate their susceptibility are most likely to end up addicted. They assume, however, that individuals learn from experience about their own susceptibility, albeit sometimes only after they have already become addicted when they no longer have an incentive to stop taking the drug. Gruber and Kosczegi (2001) further relax the assumption of rationality, modifying Becker and Murphy's model by introducing hyperbolic time discounting, which leads to systematic time inconsistency, as well as misprediction of future behavior if addicts are naive about their own preferences (on this point, see e.g., O'Donoghue and Rabin, 1999).

Researchers outside of the field of economics have also proposed explanations for the paradox of initial drug use. Some have posited that addicts do not notice that they are becoming addicted because the development of drug-dependence is so gradual (Herrnstein and Prelec, 1992; Heyman, 1996). Others have found positive support for a variety of additional causal factors, such as steep discounting of future consequences (Bickel and Marsch, 2001; Giordano et al., 2002), genetics (Crabbe, 2002), and peer influences (Niaura, 2000; Westermeyer, 1999).

While not denying that drug use has some rational component, that people may exhibit time-inconsistency but be naïve about it, or the importance of the other factors discussed in the literature, we test for the operation of an additional possible factor that may play a role in initial decisions to take addictive drugs. We hypothesize that *people systematically underestimate the motivational force of drug craving on their own future behavior*. As a result, they may begin taking drugs with an unrealistic view of how easy it will subsequently be to quit.

The concept of craving plays a central role in the psychological literature on drug addiction, (e.g., Marlatt, 1987). Craving refers to a "strong desire or intense longing" for a drug which produces a powerful, often overwhelming, urge to consume the drug (Kozlowski and Wilkinson, 1987, p. 31). Almost all drugs, including cocaine (which at one time seemed to present the anomalous case of an addictive drug that did not produce withdrawal or craving) have been shown to produce craving (Gawin, 1991). While the economic models of addiction discussed above do not deal explicitly with the effect of craving, several recent models give craving a central role. Loewenstein (1999) proposes a 'visceral account' of addiction that highlights the role of craving. Laibson's (2001) 'cue-theory' likewise assumes that drug addiction arises from craving, which itself results from a psychological process known as classical conditioning. Most recently, Bernheim and Rangel (2004) argue that drug craving produces a disconnect between the addict's motivation to obtain the drug and the pleasure that the addict will derive from taking it.

With the exception of Loewenstein's account, however, these models do not incorporate systematic misprediction of craving.[1]

Prior research has not addressed this issue directly. There is some research showing that young cigarette smokers significantly underestimate their own risk of becoming addicted (Slovic, 2001). For example, one study found that only 15% of high school students who smoked less than one cigarette per day predicted they might be smoking in 5 years when in fact 43% were still smoking 5 years later (Johnston et al., 1993). And, among high-school seniors who smoke, 56% predicted that they would not be smoking 5 years later, but only 30% had in fact quit at that point (Department of Health and Humans Services; cited in Gruber, 2001). However, there are many reasons why smokers may mispredict their own future behavior other than that they underestimated the impact of drug craving.

There is also considerable evidence, for a wide range of non-drug-related drive states – e.g., hunger, thirst, fear, sexual arousal and pain – that people who are not experiencing these states tend to underestimate their motivational force (see Loewenstein et al., 2003 for a review of findings and an integrative model). For example, in one study, thirsty subjects who had just exercised and non-thirsty subjects who were preparing to exercise, read a description of hikers who got lost in the woods and rated whether they thought the hikers would prefer to receive food or water, as well as what they themselves would prefer if they were in the hikers' position (Van Boven and Loewenstein, 2003). Subjects who were thirsty, because they had just exercised, were more likely to predict that the hikers, and they themselves, would prefer to receive water than were subjects who were not thirsty because they had not yet begun to exercise.

Another series of studies focused on the endowment effect (Kahneman et al., 1990). The endowment effect bears some similarity to addiction in the sense that it refers to a situation in which 'consuming' an object radically increases one's taste for it. In these studies, people were shown objects and were either asked to predict how much they would value the objects if they were endowed with them (Loewenstein and Adler, 1995) or to predict the valuations of other people who were given the objects (e.g., Van Boven et al., 2003). Both sets of studies showed that people under-predicted their own and other peoples' susceptibility to the endowment effect. In addiction, the studies involving predictions of other people's valuations showed that this misprediction was not reduced by feedback, but was virtually eliminated by endowing the person making the prediction with the object in question (presumably giving them an appreciation for what it would be like to be attached to the object).

The design of the current study most closely follows that of an earlier study that demonstrated under-appreciation of food deprivation (Read and van Leeuwen, 1998). In that study, subjects chose whether to eat healthy but unsatisfying snacks or unhealthy but filling snacks on a day the following week at a time when they could either expect to be food deprived (in the late afternoon) or at a time when they could be expected to be food satiated (right after lunch). In addition to varying the subjects' likely level of hunger at the time when they expected to receive the snack, the researchers also varied their level of hunger when they made the decision, by having them choose either in the late afternoon or right after lunch. Normatively, one's choice of snack should be determined by the level of hunger one expects to experience at the time of receiving the snacks, and not one's hunger at the time when one makes the decision. However, supportive of the idea

[1] Gruber (2001) discusses under-prediction of addiction in the context of smoking, but does not directly connect it with under-appreciation of the motivational force of craving.

that hunger is easier to imagine when one is hungry, choices were affected not only by the time when the snack would be received, but also by the time of day, and hence level of deprivation, when subjects made the decision. A common finding is that people tend to eat more filling, less healthy, snacks when they are hungry, and subjects were more likely to choose unhealthy high-calorie snacks when they made their decision at a time of day when they would be likely to be hungry.

The idea that drug addiction would fit such a pattern is intuitively plausible. Although drug addiction is notorious for producing horrendous behaviors, such as stealing from one's parents and abandoning one's children, when one is not addicted it is difficult to imagine *any* force that could induce one to take such actions.[2] However, empirically documenting such under-appreciation of future craving is difficult. Unlike water and food deprivation or attachment to objects, which most people experience routinely and can be easily induced experimentally, serious drug craving is only experienced when one is addicted to a drug. Clearly, it would be unethical to expose non-drug-users to drugs to see if they fully appreciate how dependent they would become once they became addicted.

It is, however, possible to address a closely related issue: whether people who are already addicted to drugs but are currently drug satiated can appreciate the motivational force of their own future craving. Most long-term addicts have experienced repeated intense drug deprivation, so if Orphanides and Zervos (1995) are correct in assuming that people learn from experience about their own susceptibility to drug craving, one would expect experienced addicts to appreciate the force of drug craving.

We used a within subject 'repeated measures' design to test whether experimentally varied deprivation and satiation would affect drug addicts' choices between drug and money. Half of the time, addicts made the choice between drug and money at a time when they could be expected to be maximally craving (right before receiving their current treatment) and half the time when they could be expected to be satiated (right after receiving their current treatment). In addition, half the time subjects made a choice that would go into effect later the same day, and half the time they made a choice that would be implemented 5 days later. Logically, whether an addict is currently craving a drug because they are about to receive treatment, or are satiated because they have received treatment, should not affect their future desire for a drug. Hence, a finding that transient, experimentally induced, changes in deprivation-states affect valuations of future drugs would strongly suggest, at a minimum, that they make systematic errors in predicting the motivational force of their own craving.

1. Methods

1.1. Subjects

Subjects were 13 adult (8 male, 5 female) heroin addicts. Their mean age was 37.5 years (S.D. = 7.6 years), they reported an average of 11.9 years of addiction (S.D. = 8.7 years), and had used an average of five bags of heroin intravenously per day (S.D. = 3.4 bags) prior to treatment. Although this is an unusually small sample size, particularly for economics, it is a within-subjects

[2] In a casual survey of undergraduates taking his seminar on drug abuse, Loewenstein asked whether they thought it was possible, if they became addicted to heroin, that they might steal from their parents to obtain a fix. Students unanimously and vehemently denied the possibility that they would behave in such a fashion.

design. Addicts are not being compared to one another, or to non-addicts, but to themselves in different experimental conditions. Despite the small sample size, the consistency of the results, both across subjects and trials, suggests that the results are reliable.

Subjects were required to remain abstinent from illicit opioids throughout the study. To ensure compliance with the abstinence criterion, urinalyses were conducted two or three times per week. A single sample that indicated illicit opiate use resulted in discontinuation from the study for one treatment cycle. A second positive test resulted in permanent ejection from the study.

1.2. Dependent measure

Subjects made real choices between receiving an extra dose of the opioid agonist medication Buprenorphine[3] (BUP) or receiving different money amounts using a discrete choice version of the Becker et al. (1964) truthful revelation procedure. For all choices, subjects saw a list of 12 amounts of money ($0, $5, $10, $15, $20, $25, $30, $40, $50, $60, $75, $100) and for each amount indicated whether they would prefer to receive (on a particular day) that much money or an additional 24-h maintenance dose of buprenorphine (a constant drug dose).[4] Although a single dose of BUP is sufficient to eliminate addicts' acute cravings, a double dose produces a longer, more satisfying high.

Subjects were told that one of the 12 choices they made would randomly be chosen to count. Subjects were instructed that "It is important that you give each decision careful consideration because *one of the 24 choices* that you have made will be selected at random and you will receive the selected outcome during the Day X Choice Session" (where X indicated the day on which they would receive their choice). The main dependent measure was the lowest dollar value at which money was preferred to an extra maintenance dose of BUP. In addition to the main dependent measure, we also collected various measures of deprivation to ensure that the manipulation of deprivation was successful.

1.3. Sequence of study

During the 3 weeks prior to running the experiment, subjects were given daily administrations of their maintenance dose of BUP. Once during the second of these 2 weeks, and once during the third, subjects received an extra dose of BUP—to give them experience with the effects of an extra dose before they began the choice session phase of the study. It was important to familiarize them with the experience of receiving an extra dose because the value that they placed on receiving such a dose constituted the main dependent variable of the study.

During the 8-week study period, subjects participated in eight choice sessions. The sequence of buprenorphine doses and choice sessions within the 14-day cycle is diagrammed in Table 1.

[3] Buprenorphine hydrochloride (Reckitt & Colman; Hull, England) was prepared as a stock concentration of 16 mg/ml in 35% ethanol (vol/vol). Stock solutions containing 2, 4, 8, 10 and 12 mg/ml in 35% ethanol (vol/vol) were prepared from serial dilutions of the 16 mg/ml stock. All medication was administered sublingually with a Ped-Pod Oral Dispenser (SoloPak Laboratories, Franklin Park, IL, USA). Subjects then held each 24-h maintenance dose of buprenorphine under their tongues for a period of 5 min without speaking. For a more detailed description of the dosing procedure, see Giordano and coworkers (2002).

[4] Subjects received either 4 mg/70 kg ($n = 2$) or 8 mg/70 kg ($n = 11$) of BUP per day. We determined which of these corresponded to a subject's daily 'maintenance dose' of BUP using a standard procedure.

Table 1
The 14-day cycle of choice sessions and buprenorphine doses used during the final 8 weeks of participation

Cycle day	Events
Day 0	Quintuple dose
Day 5	Elicit valuations of BUP applicable to Day 10 •Satiated—receive quintuple dose before valuing BUP •Deprived—receive quintuple dose after valuing BUP
Day 10	Elicit valuations of BUP applicable to end of current treatment session •Satiated—receive single dose before valuing BUP •Deprived—receive single dose after valuing BUP Receive outcome of choice randomly selected from those made on Day 5 and those made on day 10—either an extra dose of BUP or an amount of money
Day 11	Double dose
Day 13	Double dose
Day 15/0	Repeat cycle

Note: In the satiated condition, choices were made 2 h after the administration of BUP. In the deprived condition, choices were made 5 days after the administration of BUP, prior to that day's treatment.

On Days 0 and 5, subjects received quintuple doses.[5] The quintuple dosing on these days induced mild withdrawal at the start of the choice sessions scheduled on Days 5 and 10, respectively. Choice sessions were conducted on Days 5 and 10 of each dosing cycle. Delay treatment values were elicited on Day 5 of the cycle and, if they ended up counting, went into effect on Day 10. Immediate treatment values were elicited on Day 10 of the cycle and, if they ended up counting, went into effect later that day. Thus, on Day 10, subjects received either a single 24-h maintenance dose and an amount of extra money, or a double dose, depending on the outcome of one of the choices made either on Day 5 or on Day 10 (i.e., the same day). Which of the two choices was implemented was decided based on a coin flip, and subjects were told at the outset that this would be the case. On Days 11 and 13, subjects received double doses. These additional days were included in the cycle to allow the effects of any extra buprenorphine, if administered, to wash out and to coordinate the study with the work-week. On Day 15/0, a new cycle began with a quintuple dose.

Over the four 2-week cycles, each subject was exposed to each combination of treatment conditions twice. For all subjects, the sequence of choices was: deprived/delayed, deprived/immediate, satiated/delayed, satiated/immediate, satiated/delayed, deprived/immediate, deprived/delayed, and satiated/immediate. This sequence resulted in four choice sessions in which the participant was opioid deprived and four in which the subject was opioid satiated. Across both the satiated and the deprived conditions, four choice sessions involved delayed outcomes and four choice sessions involved immediate outcomes.

[5] A single daily maintenance dose prevents opioid withdrawal symptoms for a 24-h period. Opioid-dependent individuals can be maintained on buprenorphine for periods greater than 24 h by administering multiples of the daily maintenance doses. For example, administering double, triple, or quadruple the daily maintenance dose will prevent withdrawal symptoms for 48, 72, and 96 h, respectively. Administering quintuple the daily maintenance dose, however, will not effectively prevent withdrawal symptoms for 120 h. Subjects begin experiencing craving some time between 96 and 120 h (Gross et al., 2001; Petry et al., 2001).

2. Results

Three measures were taken to ensure that the deprivation manipulation was successful: (1) subjective ratings of symptoms associated with opiate 'high', (2) subjective ratings of symptoms associated with opiate craving, and (3) eye pupil radii (a common measure of opioid deprivation). Comparisons of these measures revealed differences in these measures that were consistent with the intent of the deprivation manipulation. Ratings of symptoms of opiate high were significantly increased ($F_{1,12} = 10.6$, $p = 0.007$) when subjects were opioid satiated ($M = 1.4$, S.D. = 1.3) compared to when they were opioid deprived ($M = 0.9$, S.D. = 1.1). Ratings of craving were significantly increased ($F_{1,12} = 7.02$, $p = 0.02$) when subjects were opioid deprived ($M = 3.6$, S.D. = 1.8) compared to when they were opioid satiated ($M = 2.4$, S.D. = 0.9). Pupil radii were also significantly increased ($F_{1,12} = 76.5$, $p < 0.001$) when subjects were opioid deprived ($M = 5.8$, S.D. = 0.7) compared to when they were opioid satiated ($M = 5.0$, S.D. = 0.7).

Given that whether addicts made the decision either before or after receiving their current dose was manipulate according to a rigid experimental schedule, the addicts' experimentally induced level of craving can be assume to be uncorrelated with their level of craving 5 days later. Thus, much as in the Read and van Leeuwen study, there is no plausible rationale for why the addicts' valuations of BUP should differ between these two conditions. If addicts can appreciate the force of their own future drug deprivation even when they are satiated, then their current level of experimentally induced craving should not affect the money values they place on delayed BUP. If, however, they under-appreciate the force of their own future drug craving, they should place a higher money value on Buprenorphine when they are currently experiencing the effects of drug deprivation than when they are not.[6]

The main results are shown in Fig. 1, which provides a detailed breakdown of individual subjects' valuations of the extra dose of BUP in the four treatments and also displays medians (as vertical lines). We report medians and the distribution of individual data points rather than means for several reasons. First, the interval between successive money amounts in the choices presented to the subject was not constant. Secondly, the distribution of responses was non-normal. Lastly, five subjects chose Buprenorphine exclusively in at least one of the eight choice sessions (i.e., they preferred it at an unknown amount greater than $100). Although the exact monetary value these subjects attributed to an extra 24-h maintenance dose of BUP was not determined, we could readily rank their responses relative to their other choices.

To test for differences in the money value of an extra maintenance dose of buprenorphine across treatment conditions (the main issue addressed by the study), for the same reasons that we report medians rather than means, we used a nonparametric, repeated measures analysis of variance based on ranks. This analysis, which is summarized in Table 2, is a generalized version of Friedman's Rank test applied to data with a 2×2 factorial structure, i.e., deprivation level

[6] Although our main focus is on the impact of craving on addicts' valuations of delayed BUP, the experimental design also allows us to compare addicts' valuations of immediate and delayed BUP. There are reasons to expect that addicts would display a greater preference for BUP relative to money when both could be received immediately than when both would be received only after a delay. First, while money can be borrowed and lent, and should hence normatively be discounted at the prevailing interest rate, doses of BUP cannot be traded, so the addict's discount rate rather than the market interest rate should determine the impact of delay. The predicted pattern would follow if addicts' subjective discount rates are greater than market rates of interest. Second, if addicts discount the future hyperbolically rather than exponentially, as prior research has shown to be the case (Giordano et al., 2002), then the impact of immediacy should be greater for BUP, which provides short-lived immediate benefits, relative to money, which provides benefits extended over time (see, Read et al., 1999).

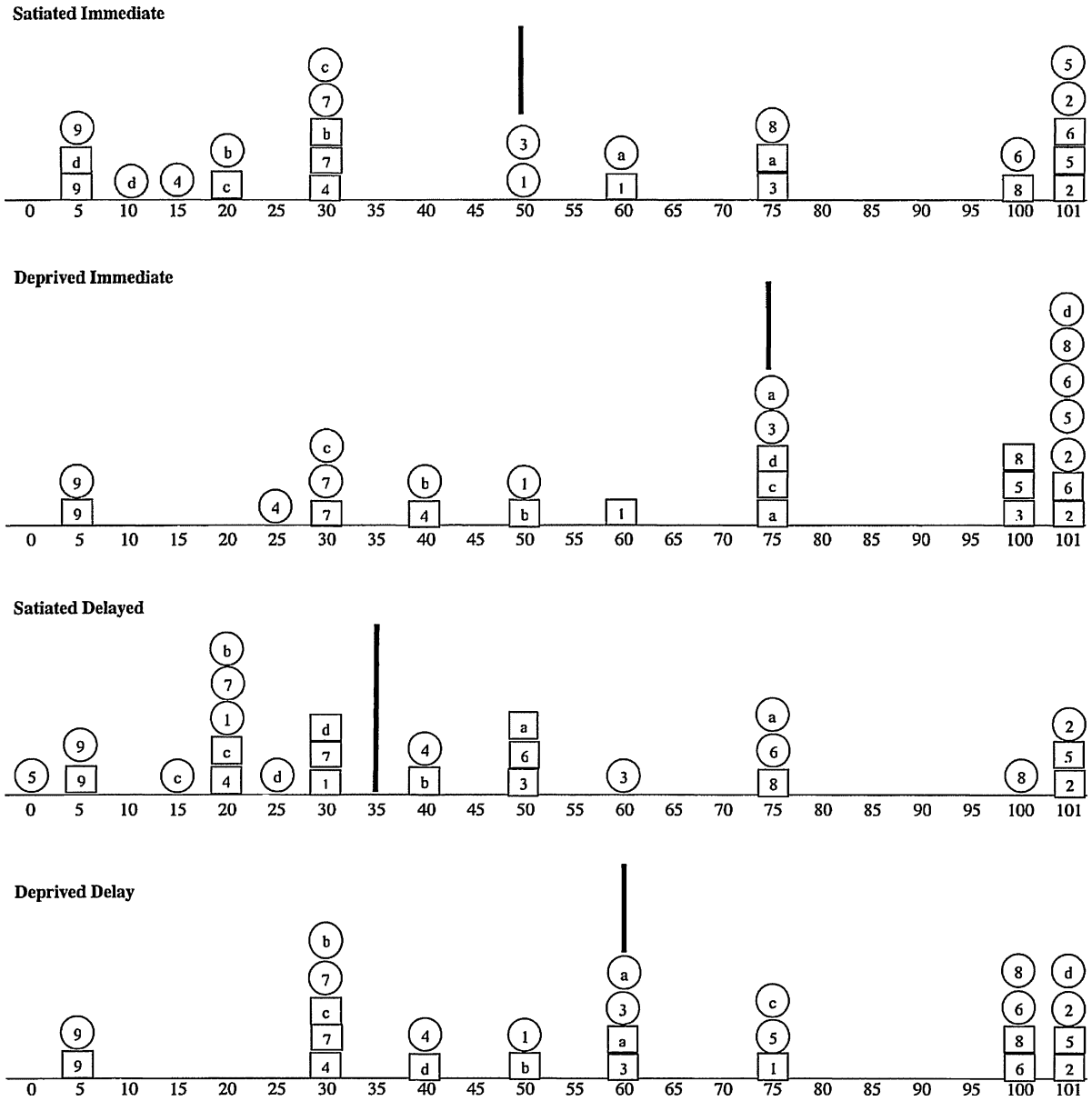

Fig. 1. Individual subjects' valuations of the extra dose of BUP in the four conditions. Each subject provides two data points in each panel. Squares indicate subjects' first valuations in each condition; circles indicate their second valuations, with a unique number or letter identifier for each subject. Vertical lines indicate medians.

Table 2
Results from analysis of variance

ANOVA table					
Source	df	Mean square	F	p-value[a]	Variance component[b]
Deprivation state	1	38.08	23.12	<0.001	$\sigma^2_{\text{state}} = 1.42$
Delay	1	10.62	6.45	0.015	$\sigma^2_{\text{delay}} = 0.36$
Delay × state	1	0.16	0.10	0.916	$\sigma^2_{\text{d×s}} = 0.00$
Error	36	1.65			$\sigma^2_{\text{error}} = 1.21$

[a] Exact significance level based on 50,000 simulations.
[b] Estimated variance components based on restricted maximum likelihood estimation (REML).

(satiated & deprived) and delay (immediate & delayed 5 days). The exact significance levels of the *F*-statistics corresponding to each factor were determined based on a randomization test done via simulation.[7]

Statistical analysis revealed a main effect of immediate deprivation on choice ($F_{1,36} = 23.12$, $p < 0.001$). The median minimum money amount preferred to an extra dose of buprenorphine was greater when subjects were opioid deprived, whether the dose or money was to be delivered immediately or after 5 days as compared to when they were satiated. When subjects were opioid deprived they valued an immediate extra dose at $75, but they valued the same dose at $50 when they were not deprived (even though both doses would be received on top of an initial dose). More importantly, when subjects were opioid deprived they valued an extra dose 5 days later at $60, but valued the same dose at only $35 when they were not deprived. As is evident from these values, the median lowest dollar amount preferred to buprenorphine was also significantly greater when outcomes of choices were immediate versus when they were delayed ($F_{1,36} = 6.45$, $p = 0.015$). There was, however, no evidence of an interaction between delay to outcomes of choice and opioid deprivation ($F_{1,36} = 0.1$, $p = 0.916$); immediately experiencing the effects of drug deprivation seems to enhance one's ability to predict the effects of future deprivation whether it will occur in the immediate future or 5 days later.

Finally, there was also no evidence of learning over time. The difference between the first and second valuations in specific conditions (e.g., deprived, delayed choice) did not approach statistical significance ($F_{1,84} = 0.1$, $p = 0.852$). That subjects did not learn to moderate their valuations as a result of their experience during the experiment is not particularly surprising, given that they had apparently not learned to fully appreciate the motivational impact of craving from the substantial exposure to conditions of deprivation and satiation that most had experienced in the past.

3. Conclusions

This is the first study, to the best of our knowledge, that examines the ability of addicts to anticipate the motivational strength of their own future drug craving. Our results suggest that addicts under-appreciate the effects of deprivation when they are not actually deprived.[8] If the same is true for non-addicts, this may help to explain the paradox of initial drug use.

It is possible, of course, that drug addicts are unusual in this respect. Indeed, as Orphanides and Zervos (1995) propose, it could be that people become addicts exactly *because* they under-predict the impact of craving on their own preferences—i.e., that people predict their own susceptibility

[7] The significance of the *F*-statistics corresponding to the rank transformed data were determined based on 50,000 random rearrangements of each subject's data This yields an approximation to the exact significance level independent of any distributional assumptions. These estimated were virtually identical to the significance levels computed based on the *F*-distribution.

[8] It is logically possible that the observed pattern of results does not reflect under-prediction of the impact of craving when currently satiated, but rather the over-prediction of the impact of craving when currently deprived (or the combination of both). We believe this alternative interpretation is unlikely. First, it is intuitively more plausible that people make mistakes when they are in one visceral state predicting their behavior in another, rather than when they are in one state predicting their behavior in the same state. When one is in a particular state, figuring out what one would want in that state simply involves figuring out what one wants at that moment; figuring out what one would want in a state different from the state one is in is inherently more problematic. Second, in several of the studies conducted to examine mispredictions of this type in other domains, it was possible to compare people's predictions to their subsequent real valuations (e.g., Loewenstein and Adler, 1995). Invariably, the largest systematic mistakes were made by people predicting their own behavior in a state different from the one they were in.

to addiction with some error, and that those who under-predict it the most are those who become addicts. However, this seems unlikely to be the full story. Addicts may have some greater tendency to under-appreciate the force of craving than others, but they also have far more opportunities to learn about craving from their own experiences. Despite such extended experience with craving, the current study suggests, addicts do not fully appreciate the motivational force of their own craving when they are not currently in a craving state.

Moreover, as discussed, prior research has revealed similar patterns of under-appreciation of states one is not currently in for a wide range of visceral states, such as hunger, thirst, sexual arousal, curiosity, fear and attachment to objects. It seems unlikely that craving is an exception when it comes to visceral states that display such a pattern. Initial drug use by non-addicted individuals undoubtedly has many causes, but under-appreciation of the motivational force of craving seems likely to be an important contributing factor.

Another possibility is that the observed effects of deprivation versus satiation may be driven by the direct effects of the drug, in the satiated conditions, on subjects' perceptions or behavior. Although such an account cannot be ruled out, there is no obvious reason why the influence of Buprenorphine should cause subjects to put a lower value on BUP—other than the reason which led us to hypothesize that it would have such effect. Moreover, again, such an explanation fails to explain why the same pattern is observed for such a wide range of visceral states.

Beyond its implication for the initiation of drug use by those who are not yet addicted, under-appreciation of the motivational force of future craving has implications for the behavior of addicts who want to quit. On the one hand, under-appreciation of future craving will tend to cause addicts to be over-confident of their own ability to quit. At times of satiation, they are likely to have overly rosy views of their own prospects of quitting, and hence may view treatment as less necessary than it actually is, and may take insufficient measures to prevent future exposure to cues that induce craving (e.g., drug paraphernalia, or people they took drugs with in the past). On the other hand, the same under-appreciation of future craving could increase addicts' willingness, at moments when they are satiated, to take actions that bind them to abstain in the future. In combination, these countervailing effects suggest that getting addicts to quit may require the tricky balancing act of helping them to recognize their own risk of relapse, while at the same time not recognizing the misery associated with withdrawal. In fact, one of the most efficacious treatments for preventing relapse to drug use involves teaching addicts to anticipate, recognize and cope with situations that are likely to lead to reinstatement of drug use (Marlatt, 1987).

The current results also have implications for criminal justice with respect to drug use. If people who are not craving a drug underestimate the impact of drug craving on their own behavior, they are likely to view others who succumb to such craving as more blameworthy than they would if they fully appreciated the motivational force of craving, believing, incorrectly, that they themselves would never behave in such a fashion. Consistent with this idea, although not in the context of drug craving, in a series of experiments, Nordgren et al. (2006, forthcoming) induced visceral states (fatigue, pain hunger and sexual arousal) in subjects using different experimental inductions and then had them read vignettes about people whose behavior was influenced by the same state they were induced to be in. Subjects who were experimentally induced to be in a particular state were more likely than those who were not in that state to explain the behavior of the individual in the vignette on the basis of the state as opposed to factors such as a lack of self-discipline, motivation or willpower. The fact that drug laws are, presumably, enacted mainly by people who are not themselves addicted to drugs, could easily lead to an excessively punitive legal response to drug addiction, one premised on the belief that addicts are capable of quitting if they are simply given sufficient motivation to do so.

Given the specialized nature of the sample, more research is needed to verify that underprediction of craving is an important determinant of initial drug use. However, the current results, at minimum, suggest it as a hypothesis worth exploring. At a more general level, this study reinforces the view, already prevalent in behavioral economics, that systematic errors of judgment can and do exist, and that understanding such errors can help to shed light on economic behaviors that are otherwise difficult to make sense of.

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