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Craving for drugs

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The image of craving as a desire of unimaginable and irresistible force is poised to solve the puzzle of addiction: persistent drug use despite severe negative consequences. But the image is flawed. Drawing on science, philosophy, and first-person testimony, I argue against irresistibility and develop a more nuanced, heterogeneous account of craving for drugs. Craving comes in three varieties, each corresponding to a kind of answer to the question why people crave drugs: cue-induced, goal-focused, and attachment-based. This in turn grounds an approach to addressing addiction that is humane and heterogeneous, moving beyond strategies that are fundamentally controlling.

KEYWORDS

addiction, animal models, craving, irresistible desire, learning theory, policy, treatment

1 | CRAVING AND THE PUZZLE OF ADDICTION

Do you ever crave company, solitude, sex, food, or drugs of any kind—a coffee, a smoke, an oxy, a glass of wine? For most of us, for at least some of these things, the answer is obvious. *Yes*. For all who answered yes, let me ask another question. When you have such a craving, is it irresistible? Before you answer, a qualification. The word "irresistible" can mean different things in different contexts of use. So let me be more specific: When you have a craving, and assuming that you are not addicted to the thing you are craving, is your craving irresistible in the way we commonly take craving in addiction to be? Thus specified, for most of us, the answer is just as obvious. *No*. Of course you may really, really, really want whatever you crave.

You might want it so much that you act rashly—perhaps breaking a past resolution or knowingly risking future regret. But however strong your craving is, you would probably distinguish it from the irresistibility supposed to characterize craving for drugs in addiction. Your desire for companionship or solitude does not compel you to act in the way that drugs compel people with addiction to act. Nor are you forced to eat the food, have the sex, or take the drugs.

The image of craving in addiction as different in kind from ordinary craving—different in kind precisely because irresistible in the sense of compelling action—has long shaped scientific, philosophical, and popular imagination. Consider the famous ode to craving penned by Benjamin Rush, repeated by Williams James, and liberally quoted ever since:

> The craving for drink in real dipsomaniacs, or for opium or chloral in those subjugated, is of a strength of which normal persons can form no conception. "Were a keg of rum in one corner of a room and were a cannon constantly discharging balls between me and it, I could not refrain from passing before that cannon in order to get the rum"; "If a bottle of brandy stood at one hand and the pit of hell yawned at the other, and I were convinced that I should be pushed in as sure as I took one glass, I could not refrain": such statements abound in dipsomaniacs' mouths (James, 1890, p. 543; Rush, 1812, p. 266).

Craving is here portrayed as a desire of unimaginable strength to "normal persons"—a desire so strong it is impossible to resist, no matter the consequences of acting on it, including cannonballs and hell. This, of course, is literary license. People with addiction do not actually face the inferno. But they do face losing family, friends, jobs, housing, health, and, in jurisdictions that criminalize drug possession, basic freedom—in virtue of using drugs. These concrete losses often exist alongside corresponding feelings of shame, grief, despair—and the particular distress of not being able to make sense of one's behavior to oneself (see below, Section 3.3). What could make someone keep using drugs, despite harrowing consequences such as these? This is what I have called "the puzzle of addiction" that any theory of addiction must explain: Why use drugs, when the costs of doing so appear so destructive compared to the benefits, such that using just isn't worth it (Pickard, 2016, 2018, 2020, 2021)?

The answer to the puzzle provided by Rush, echoed by James, and with us to this day, is *craving for drugs*. The thought is that, if people with addiction could stop using, then they would. We all act, in so far as we can, in our own best interests and the interests of others we care for. But people with addiction can't stop using, which is why they don't. This incapacity is what explains the apparent lack of self-concern in risking death and eternal damnation for a keg of rum or bottle of brandy. But what, in turn, explains this incapacity? Craving for drugs, depicted as a force so strong as to be inconceivable to "normal persons" and impossible to resist, effectively crushing the possibility of choosing life and salvation over use. Thus portrayed, craving offers an elegant and powerful solution to the puzzle. By contrast with more ordinary cravings for all sorts of things (drugs included), cravings for drugs in addiction are supposed to be impossible to resist, compelling action that satisfies them—no matter the costs.

Notwithstanding its elegance and power as a solution to the puzzle of addiction, this image of craving is fundamentally flawed. Cravings for drugs in addiction are not irresistible. Indeed, in some cases, they may be little different from ordinary cravings. This matters—for how we think about the nature of addiction, for how we think about people who suffer from it, and for how we might think about trying to help. Or so I shall argue.

My aim is to develop a more nuanced understanding of craving and rectify the damage done by this false image.

A brief guide to what follows. The remainder of the article divides into two major sections, each with multiple subsections. Section 2 lays the foundation for Section 3 by addressing what craving is *not*: irresistible desire. I am hardly the first to argue this. Although the image has had its champions, the past decades have witnessed widespread recognition within philosophy—no doubt influenced by models of addictive decision-making proposed by behavioral economists and cognitive scientists—that, however drug use in addiction is to be explained, it is not compelled by irresistible desire, but, at least to some degree, voluntary or chosen.[1] Nonetheless, the dominant paradigm in addiction neuroscience and public health policy—and the official position of the National Institute on Drug Abuse—is that addiction is a brain disease of compulsion, with animal models at the center of addiction research, and pharmacotherapy to block craving and withdrawal at the center of addiction treatment[2]; meanwhile, popular depictions of addiction frequently echo this paradigm and the image of craving it contains.[3] There is therefore reason not only to review evidence previously mustered against the irresistibility of craving, but to engage directly with animal models. This engagement comprises the bulk of Section 2. I draw on learning theory and the history of animal models, in conjunction with relevant human studies, to establish that drug desires in addiction are not irresistible. But, in so doing, I also consider what it would mean for any desire to be irresistible and how best to operationalize the construct. There is, in consequence, a philosophical lesson to be learned from engagement with the science. Given their role in action explanation, we should be skeptical that desires could be irresistible. I conclude Section 2 by considering a natural objection to it. Section 3 then builds on the foundation laid in Section 2, by reflecting on the landscape of desire, both in general and in addiction, to explain what craving *is*—and why it matters that we recognize it for what it is. I argue that there are three kinds of answer to the question of why people crave drugs, each corresponding to a variety of craving that I call cue-induced, goal-focused, and attachment-based; I delineate these varieties using science and philosophy, and illustrate them using fiction and first-person testimony. Human craving for drugs is therefore *heterogeneous* (Flanagan, 2020). I conclude Section 3 by putting this heterogeneity to work to rectify the damage done by the false image. To anticipate, I suggest it grounds a correspondingly heterogeneous approach to addressing addiction, moving beyond a narrow focus on control of drug supply, drug users, and drug desires.

[1]Philosophical champions of the irresistibility of cravings since Rush and James include Charland (2002), Elliott (2002), and Frankfurt (2003 [1971]). Apart from myself, philosophical objectors to the view include Flanagan (2011, 2013, forthcoming), Foddy (2017), Foddy and Savulescu (2006), Holton and Berridge (2013), Levy (2006, 2011), Sripada (2018, 2022a, 2022b), Wallace (1999), Watson (1999), and Yaffe (2001, 2011). For some representative supporting articles in behavioral economics and cognitive science, see Ainslie (2018), Heather (2017), Herrnstein and Prelec (1992), Heyman (2009), Rachlin (1997), and Redish et al. (2008).

[2]https://nida.nih.gov; see also Volkow et al. (2016); Leshner (1997) is the classic statement. Note that, although I have elsewhere argued that we should be agnostic about whether addiction is, in all cases, a brain disease (Pickard, 2022), this is not my target here, but rather the characterization of cravings as irresistible and use as correspondingly compelled. Rejection of this characterization is compatible with retention of a brain disease model: addiction could be a brain disease *of choice*. See Berridge (2017, 2022), Heilig et al. (2021), and Pickard (2022).

[3]For example, consider the journalist Beth Macy's acclaimed book *Dopesick* (2019). Although Macy meticulously documents the role of poverty, pain, and hopelessness—alongside lack of regulation and corporate deception and greed—in creating the US opioid epidemic, her model of addiction is largely that of a "hijacked" brain overcome by cravings to use in order to avoid withdrawal.

2 | WHAT CRAVING IS NOT

2.1 | Irresistible desires

What would it be for a desire to be irresistible? The idea of a force so strong as to be impossible to resist invites interpretation through physical metaphors: water bursting through a dam (Wallace, 1999); bladders and lungs full to the point of exploding (Watson, 1999); a train with no brakes barreling down a track. Can these metaphors be made good?

Gary Watson (1999) suggests the following analysis. Just as, if you try your hardest to move a slab of stone, giving it your absolute all, but fail, then you can't move the stone, so, too, if you try your hardest to resist a desire, giving it your absolute all, but fail, then you can't resist the desire. But, Watson then argues, in contrast to moving a stone, you cannot give your absolute all to resisting your own desire. The reason is that part of you, your desire, is resisting your resistance. You are psychologically conflicted, not wholeheartedly of one mind. Hence the antecedent of the conditional cannot be met, leading Watson to skepticism about the possibility of irresistible desires.

Although I will ultimately agree with Watson's skepticism, I do not think we can yet draw this conclusion. Watson's conditional functions as an operationalization of the construct of irresistibility. We observe whether someone is trying their hardest to resist a desire. Then we observe whether they act. If they act, the desire counts as irresistible. If they don't, it doesn't. The problem with this operationalization is that it presupposes a subject susceptible to psychological conflict: capable of taking metacognitive attitudes toward first-order mental states, for example, of resisting their own desire. Yet, name notwithstanding, nothing in the idea of an irresistible desire—depicted as a physical force of such strength as to be unstoppable by various objects it encounters, such as dams, bladders, lungs, anything unfortunate enough to find itself in the way on the tracks—should block its ascription to animals incapable of metacognitive attitudes. Crucially, this includes one of the animals at the heart of addiction science, namely, the rat. What we should expect, if drug desires are "irresistible" in rats whose behavior mirrors, so far as possible, human addiction, is not that *attempts to resist drug desires fail*—since rats make no such attempts—but that *drug desires always win out*. How then to make good this new metaphor of winning out? To do so, the idea of irresistibility must be operationalized along two dimensions. On the one hand, drug use must evince *behavioral inflexibility*—use persists, no matter what. On the other hand, this behavioral inflexibility must be explained by *desire*.

Early experiments attempting to model addiction in rats indicated behavioral inflexibility. A classic experimental chamber contains a lever that, if pressed, delivers reward: water, food, or an intravenous drug dose—typically a psychostimulant or an opioid. Rats are curious animals. When first placed in the chamber, they explore. In textbook experiments, a light goes on. The light functions as a stimulus, signaling reward availability. At some point, the rat happens to press the lever. The reward is delivered. The delivery of the reward is then signaled by a second stimulus, like a second light or a sound. These cues, signaling reward availability and delivery, help the rat learn to instrumentally press the lever to receive the reward; but, once this is learned, their presence has minimal effect on self-administration. In this way, rats learn how to self-administer rewards, including drugs.

Rats in early experiments who were given unlimited access to cocaine self-administered until death (Bozarth & Wise, 1985).[4] Cocaine is an anorexigenic. It suppresses hunger and

[4]In contrast with heroin. For discussion, see Bozarth and Wise (1985), Vandaele et al. (2016), and Ahmed (2017).

thirst. The rats pressed the lever repeatedly for cocaine—forsaking food and water. Within three weeks, 90% died, presumably from exhaustion, starvation, and dehydration. What would make any animal forsake natural rewards essential to survival? The instinctive answer is: the power of drugs to compel use. This image of the rat pressing the lever again and again—abandoning itself to cocaine at the expense of food and water—is the animal model of risking death and eternal damnation for a keg of rum or bottle of brandy. The first dimension of the operationalization appears to be met. Use persists, no matter what. The question is: Is this behavioral inflexibility explained by desire?

2.2 | Learning theory

The animal drug self-administration paradigm developed within a learning theory framework, which distinguishes two basic kinds of operant behavioral response. *Habitual* or stimulus–response (S–R) behavior is controlled by a stimulus, for example, a cue, such as the light described above, that the animal has learned to associate with the reward. By contrast, *goal-directed* behavior is controlled by a representation of the outcome—the expected reward—that the animal has learned can be achieved by a behavioral response. In other words, it requires the animal to represent the response–outcome (R–O) relationship or "contingency", as it is called. Goal-directed behavior is thus naturally explained by belief–desire psychology. Why does the animal press the lever? Because it believes doing so will deliver the reward and it desires the reward. Note the striking parallel here between learning theory and the philosophy of action. Arguably, the orthodox view in the philosophy of action is that what makes a piece of behavior an action is that it is explained by the agent's reason for acting, understood as a belief–desire pair, where the agent believes that the means to satisfying a current desire is to act as they do: Action is goal-directed.[5] Unlike goal-directed behavior, habitual behavior is *autonomous* from the outcome, in the sense that the behavior is directly controlled by the stimulus rather than directed at a goal. There is no mediation by an R–O representation and hence no explanation of the behavior by a belief–desire pair.

The operationalization of the distinction between habitual and goal-directed behavior is differential sensitivity to the manipulation of belief or desire. Belief can be manipulated by degrading the learned R–O contingency, a procedure known as "contingency degradation". The idea is simple: Make it the case that the animal no longer believes the behavior is an effective means to achieving the desired outcome. For example, having learned that pressing a lever reliably delivers a reward, the delivery schedule is altered to be independent of lever-pressing. When the reliable pairing between behavior and outcome is disrupted, the animal's belief in this contingency changes. Desire can be manipulated by devaluing the outcome of the behavioral response, a procedure known as "outcome devaluation". Again, the idea is simple: Make it the case that the animal no longer desires the reward it expects to get by acting. Devaluation is typically achieved in either of two ways: reward-specific satiety or aversion conditioning.

[5]For classic statements in the philosophy of action, see Davidson (1963) and Smith (1998); in learning theory, see de Wit and Dickinson (2009); on their connection, see Heyes and Dickinson (1990) and, especially, Dretske (1988). Note that, although I use "action" only for behavior explained by belief and desire, this is by convention only. There are many forms of animal behavior that are *active or agential* (and so therefore have a prima facie claim to be called "action") but are not explained by belief and desire (e.g., habitual or S–R behavior, to take an obvious example); see Burge (2009), Dretske (1988), and O'Shaughnessy (1980). What matters is not what we call animal behavior (including our own) explained by belief and desire, but that it is clearly delineated from behavior otherwise explained.

Reward-specific satiety works by satisfying the desire prior to the animal entering the experimental chamber. For example, having learned that lever-pressing delivers food, a rat is allowed to eat its fill before testing. Aversion conditioning pairs the reward with an aversive experience prior to testing (e.g., an injection of lithium chloride to induce nausea), aiming to create a lasting association between them. Once the contingency is degraded or the outcome devalued, then either the rat no longer believes that lever-pressing will deliver reward, or it no longer wants the reward that it believes lever-pressing delivers. It is then returned to the experimental chamber and tested under a condition called "extinction": No reward is available should it press the lever, so its behavior cannot be influenced by present reward, but must be based on past learning. Its behavior is observed and compared to a group that has not undergone outcome devaluation or contingency degradation. Does the rat, or does it not, press the lever at a different rate? If a difference is observed, then the rat's behavior is goal-directed. The manipulation of belief or desire has had an effect. If no difference is observed, then the rat's behavior is not goal-directed. The manipulation of belief or desire has had no effect. Hence the rat's lever-pressing is not explained by a belief–desire pair. It is responding habitually. Its behavior is directly controlled by a stimulus, unmediated by a belief–desire pair. Note that S–R behavior is here defined as absence of evidence for goal-directed behavior. It is not independently operationalized. More on this below, when we turn to human drug use.

Rat experiments using food reward demonstrate that lever-pressing is initially goal-directed (Adams & Dickinson, 1981). But, over time and with training, it becomes habitual: impervious to contingency degradation or outcome devaluation under extinction. Note that there is yet a degree of behavioral flexibility. No animal will lever-press *ceaselessly* under extinction conditions; equally, if an animal is *not* under extinction conditions but allowed to sample a devalued outcome, it will typically cease lever-pressing. Nonetheless, the finding that, over time and with training, behavior that is initially goal-directed becomes habitual looks poised to explain why rats in early experiments given unlimited access to cocaine pressed the lever repeatedly—even if not ceaselessly—forsaking food and water, and risking death. The explanation is that, as with food, so too with drugs. Behavior that was goal-directed and hence sensitive to expected reward outcome becomes habitual: a direct response to a stimulus that is outcome-autonomous and unmediated by a belief–desire pair. This image of the rat in its chamber, pressing the lever again and again, is strikingly evocative of Oscar Wilde's chilling description of human addiction: "Men and women at such moments lose the freedom of their will. They move to their terrible end as automatons move" (*Picture of Dorian Gray*, 1891, Chap. 16; quoted in Holton & Berridge, 2013, p. 239).

2.3 | Habit theory

Drawing on this S–R framework, the habit theory of addiction explains the puzzle of addiction by appeal to behavior that is outcome-autonomous and in this sense "automatic" (Everitt & Robbins, 2005, 2016; Lüscher et al., 2020). I shall review the evidence for and against this theory in both humans and rats shortly. But first a general and crucial remark: The habit theory of addiction does not vindicate, but *denies*, the power of craving in explaining drug use.[6] As Peter Railton puts it, desire is "a beckoning idea that draws us forward, rather than a blank drive that

[6]Indeed, Steven Tiffany, one of the first to propose a role for S–R behavior in addiction, did so in part to explain the many cases of relapse *not* associated with craving (Tiffany, 1990).

pushes us from behind" (2012, p. 28). If habit theory is true, then the behavioral inflexibility revealed in the early animal drug self-administration experiments is precisely *not* to be explained by *desire*. Drugs do not beckon. Use is not goal-directed. Drug use is, rather, a blank drive: a kind of repetitive *mindlessness*. This is how S–R behavior is operationalized and defined: explained by psychological processes to be sure, namely, control of behavior, for example, drug use, by stimuli—but not explained by mental states like beliefs and desires. Hence, according to habit theory, craving, understood as an irresistible desire *for* an object, has nothing to do with why anyone—rat or person—continues to use drugs despite negative consequences. What explains this apparent behavioral inflexibility is that it is stimulus-controlled and so outcome-autonomous.

Although the evidence is more complicated for rats (see below, Section 2.4), habit theory is unlikely to be the correct explanation of human addiction. There is, unsurprisingly, general evidence of habit in humans, as demonstrated through field experiments. People in the habit of eating popcorn at the movies show less sensitivity to outcome devaluation than controls. So long as they are eating in a typical context and with their usual hand, it makes little difference if the popcorn is stale or fresh (Neal et al., 2011). This finding accords with common sense. Consider how, with a drink or a pack of cigarettes in front of you, anyone who drinks or smokes, addicted or not, can find themselves mindlessly reaching for it, sated or not. But getting and taking drugs (especially illegal drugs) is typically a complex affair, requiring planning, scheming, and flexibility (Daw, 2015; Pickard, 2015; Tiffany, 1990)—hallmarks of goal-directed behavior. Meanwhile, this intuitive point is supported by outcome devaluation and contingency degradation laboratory experiments. Typically, in these experiments, human subjects learn that two responses, R1 and R2, earn two distinct rewards, O1 and O2. One reward is then devalued by reward-specific satiety, adulteration, pharmacotherapy, or health warnings; or the R–O contingency is degraded by verbal instruction that the reward is no longer available. Choice of response is then tested in extinction. Habit theory predicts that addiction will be associated with habitual responding: People with addiction should be less sensitive to outcome devaluation and contingency degradation than controls. But, as Lee Hogarth has demonstrated, the majority of studies do not show this effect; meanwhile, in rare cases where it was found, it cannot safely be attributed to habit, because the subjects additionally displayed impaired knowledge of a host of contingencies (including R–O), probably arising from task disengagement or cognitive impairment; moreover, in studies where knowledge of contingencies is matched, comparable goal-directed control over behavior between addicted and non-addicted subjects is observed (Hogarth, 2020, 2022). This points to a fundamental problem operationalizing S–R behavior as absence of evidence for goal-directed behavior. There are alternative hypotheses for insensitivity to outcome devaluation or contingency degradation, namely, impairment in the psychological processes explaining goal-directed behavior, as opposed to control of the behavior by S–R processes (Vandaele & Janak, 2018). Notwithstanding the popcorn field experiments, and in striking contrast with rats, it has proven extremely difficult to train humans to behave habitually in the laboratory (de Wit et al., 2018), raising a concern that the methods used to test habitual versus goal-directed behavior in animals may have limited translational validity in general (Vandaele & Ahmed, 2021)—never mind that humans are rarely if ever in real-world conditions of extinction.

Yet something about the idea of a "drug habit" is surely compelling. There is evidence that, in both rats and humans, habitual and goal-directed behavior may work in tandem, with habits controlling the selection of goals which can then be implemented through flexible planning (Cushman & Morris, 2015; Kool et al., 2018; Vandaele & Ahmed, 2021; see also

Bargh & Ferguson (2000) for an auto-motive model of environmentally driven, unconscious, yet goal-directed behavior). Drawing on this idea, Nathaniel Daw (2015) has suggested that what is habitual in addiction is not behavior itself, but *goal selection*: which expected reward outcome is selected for action out of all those that are possible—or, we might say, *which desire*, out of all possible desires, is acted on. The actions required to find and take drugs are no doubt typically complex and instrumental: explained by belief–desire psychology, not S–R processes. But perhaps drug goals themselves, in addiction, are selected for action over other goals *mindlessly*—people with addiction act on drug desires *by force of habit*.

Could this suggestion explain the apparently unstoppable force of drug desires? Drug desires always win out because people with addiction mindlessly pursue drug goals. Remember the rat, pressing the lever again and again for cocaine, forsaking any desire it might also have for food or for water. Perhaps its behavior is not blind—drugs beckon it forward. But, the suggestion would be, it mindlessly follows its desire for drugs at the expense of all other possible goals. Drug use is therefore hypothesized to satisfy both dimensions of the construct of irresistibility. The behavior is inflexible because drug desires are inflexibly selected for action. As Carl Elliott evocatively puts something like this idea, people with addiction "must go where the addiction leads, because the addiction holds the leash" (Elliott, 2002, p. 48).

2.4 | Forced-choice studies

In theory, the suggestion has some explanatory promise. However, in practice, it turns out that neither rats nor people mindlessly follow their desires for drugs in addiction. Notwithstanding early rat experiments, drug use is not in fact inflexible.

Let us begin with rats. Inspired by Sidney Spragg's (1940) seminal work with monkeys, the animal experimentalist Serge H. Ahmed pioneered a forced-choice study paradigm with rats demonstrating that they escalate drug intake in an addiction-like manner only when no alternative rewards are available (Ahmed, 2010, 2018; Ahmed et al., 2013; see also Banks & Negus, 2012). The forced-choice experimental chamber has not one lever, but two. Each lever is retractable and paired with a separate light cue. One lever delivers a drug dose and the other an alternative reward, for example, sweet water. Self-administration training is conducted in a manner that ensures the rats do not default to either lever simply out of familiarity. Once training is complete, the rats are introduced to the forced-choice procedure. Both lights come on and both levers are extended. If either lever is pressed, the associated reward is delivered and both levers are retracted. Over a series of studies, Ahmed found that 90% of rats chose sweet water over drug reward. This was so even if (i) drug dose is high; (ii) cost of sweet water is significantly higher than cost of drug reward, as measured by number of lever-presses required to get either reward; and (iii) the individual animal has a long history of self-administration and escalation, and shows signs of withdrawal and sensitization, a behavioral measure involving locomotor hyperactivity when the drug is delivered, and associated with neural changes.[7] More recently, Marco Venniro and colleagues (Venniro et al., 2018, 2021) adapted Ahmed's forced-choice study paradigm to social reward. They found that almost 100% of rats—who were socially housed, so

[7]An important discovery is that delay of delivery of both rewards shifts choice from sweet water to drug reward (Canchy et al., 2021). The time between response and delivery is typically a matter of seconds for sweet water; meanwhile intravenous drug reward appears to peak in the order of tens of seconds after responding. Rats do not like to wait. Delaying both rewards on average 40 seconds appears to equalize the wait.

in no way socially deprived—chose social over drug reward, irrespective of training conditions, drug class, dose size, length of abstinence since last dose, and "addiction score" based on a DSM-style model adapted to rats (Deroche-Gamonet et al., 2004; Piazza & Deroche-Gamonet, 2013). Rats chose drug reward only if choice of social reward was punished by moderate to high foot shock, or delivery of social reward was significantly delayed.[8]

What do these studies show? Even when rats have a history of drug self-administration designed by experimentalists to mirror addiction, they choose alternative rewards to drugs in many circumstances. Note that, although it is natural to interpret these findings as indicating goal-directed behavior in rats, this cannot be concluded. Habits, operationalized as stimulus-controlled behavior, are not guided by a desire for an outcome, but they are nonetheless sensitive to the level of reward achieved by the behavior over the animal's learning history. When habits compete with each other, the habit associated with greater past reward will dominate (Vandaele & Ahmed, 2021). Therefore, in the forced-choice study procedure, it is at least in theory possible that rats press the lever associated with the non-drug alternative out of habit *and* because that response has been more rewarding in the past than the alternative; in other words, *not* because they are guided by a representation of the outcome of doing so.[9] Nonetheless, whether the allocation of the rats' behavior to the non-drug alternative is controlled by habitual or by goal-directed processes, it is simply false that drugs always win out. *When alternatives are available*, either other habits are elicited, or other goals are pursued instead. Hence, what explains why rats in early experiments self-administered cocaine until death is not the power of drugs in forming either habits or desires. It is the lack of anything better as they lived alone, for weeks on end, in barren, experimental chambers.

Strikingly similar findings hold for humans. As noted above, in contrast with rats, there is strong evidence that drug use in human addiction is not habitual, but goal-directed. But, similarly with rats, there is a robust, inverse relationship between drug use and the availability of alternative rewards (Acuff et al., 2019), with choice of reward in both species influenced by factors such as relative reward size, cost, delay, and, of course, consequences of either option (e.g., punishment; Banks & Negus, 2012, 2017; Hogarth & Field, 2020). Arguably the most important illustration of this point, in relation to humans, comes from contingency management (CM) treatment. CM is a highly effective therapeutic modality which in effect structures a person's environment to mirror forced-choice animal studies: Alternative rewards, such as small prizes, vouchers, money—or, as in Ken Silverman's inspired innovation of a "therapeutic workplace", skills training and employment—are available on condition of abstinence (Silverman et al., 2016; Stitzer et al., 2011; Zajac et al., 2018). CM likely works through two mechanisms. Some of the alternative rewards offered are large, for example, the skills training and employment associated with therapeutic workplaces. These may straightforwardly outweigh drug rewards. Other of the rewards are relatively small, for example, small prizes and vouchers. These may not outweigh drug rewards. Rather, the treatment may work by explicitly engaging goal-directed deliberation (Regier & Redish, 2015), thereby countering any habitual influence on goal selection (see above, Section 2.3; Tiffany, 1990) and enabling longer-term, global considerations to weigh more heavily in the balance (Bickel et al., 2014; Bickel & Marsch, 2001; Heyman, 2009). But, whatever the mechanism, the bottom line is that CM works. It is an outrage that it is so rarely available to treat addiction—for what one can only presume are ideological reasons to the tune that no one should be "rewarded" for not using drugs (Strain, 2021).

[8]See footnote 7. Note, however, that neither of these measures correlated with "addiction score".
[9]At present, the evidence for this hypothesis is mixed; see Vandaele et al. (2019, 2020, 2022).

I shall return to CM briefly in Section 3.6. The crucial point for now is that the cumulative evidence indicates that responsiveness to alternative rewards is retained in human addiction. In other words, as with rats, so too with people. Whether explained by habit (as appears at least possible in rats) or belief–desire psychology (as appears the case with people), drug behavior is not inflexible after all. In many circumstances, drugs do not win out, but are cast to the side when better rewards are available.

Hence, human drug desires are not of an inconceivable and unstoppable force; other desires are frequently acted on instead. Indeed, if we replace the literary license taken by Rush and James with qualitative studies of people with addiction, this point is borne out. Both retrospective self-report and ecological momentary assessment (EMA) studies suggest cravings are no stronger than other desires (for a review, see Sripada, 2022a, 2022b); for example, when asked how pleasant or desirable it would be to eat food, have sex, or take drugs, cocaine-addicted subjects rate food and sex over drugs "in general" (Goldstein et al., 2010).[10] Neuroimaging studies by Leonie Koban and colleagues (Koban et al., 2023) complement these findings. Using functional magnetic resonance imaging (fMRI) and machine learning, a neurobiological craving signature (NCS) was discovered, predicting self-reported strength of both cue-induced drug and food cravings. NCS response to drug cues can discriminate heavy smokers and people with alcohol and cocaine use disorders from non-drug users. However, the response to drug cues in the former as compared to the response to food cues in healthy subjects is not dissociable at the fMRI level. In other words, the difference between addicted and non-addicted individuals resides in *which cues* cause the NCS response, not in the nature of the response itself.

2.5 | Skepticism about irresistible desires

The burden of this section was to explain what craving for drugs in addiction is not. It is not a form of habitual or S–R responding, for these processes do not involve desire at all. But nor is it an irresistible desire, for drugs do not always win out. The history of animal models alongside human studies indicates that behavioral flexibility is retained and alternative goals to drugs pursued in many circumstances. In the next section, I explain what craving is. But I want to end by suggesting that, on reflection, we should be skeptical of the idea that desires could be irresistible. There is a tension between the two dimensions of irresistibility: *behavioral inflexibility* on the one hand, and *behavior that is explained by desire*—and of course belief—on the other.

Recall the contingency degradation assay used in human subjects to determine whether behavior is habitual or goal-directed: verbal instruction that the reward is no longer available—meaning that the behavior in question is no longer a means to satisfying any desire for the reward the subject may have. Consider now a hypothetical contingency degradation experiment rather than an actual one. Imagine that a person with addiction is presented with their drug of choice: Suppose a person with alcohol use disorder (AUD) is at a bar, sitting in front of what they take to be an ordinary glass of vodka, on the verge of drinking. It is their first drink of the day, and their craving is very strong—palpably so. But they suddenly get convincing evidence, for example, authoritative testimony from a person they trust, like the bartender or a friend, of one of the following: (i) the glass does not contain vodka, but poison; (ii) there is a 9:1 chance that the glass contains vodka or poison; (iii) the glass contains a 9:1 solution of vodka to poison, enough to make you sick, but certainly not kill you. Let us stipulate that they change their

[10]Interestingly, the rating is reversed if subjects are asked to imagine how pleasant or desirable it would be to eat food, have sex, or take drugs, *were they under the influence of drugs*.

belief accordingly and that their craving for vodka persists, despite this change in belief.[11] Do they drink?

This is ultimately an empirical question, but we can nonetheless make a series of plausible predictions, based on what we know of human decision-making in general, and addicted decision-making in particular. On the assumption that they do not have an independent desire to die from drinking poison, no one, however severely addicted, drinks in (i). After all, they no longer believe the glass contains *any* alcohol; drinking will not satisfy their craving. But some people with AUD might drink in (ii) and some (not necessarily the same) people might drink in (iii). In (ii), there is a 9:1 chance their craving can be satisfied by drinking. In (iii), their craving will be satisfied by drinking, but they will also get sick. Drinking in (ii) will depend in part on a person's tolerance of risk; while drinking in (iii) will depend in part on a person's tolerance of costs that are certain. Meanwhile, increasing or decreasing the 9:1 ratio in either (ii) or (iii) will of course affect what we should predict. Make the risk or quantity of poison low enough, and everyone will drink; make the risk or quantity of poison high enough, and no one will. Different people will have different tolerance thresholds, creating significant individual variability in the cut-off point for drinking.

What this hypothetical contingency degradation experiment suggests is simply that, *holding craving in addiction constant*, changes in belief relating to the object of a craving and hence to R–O contingencies affect whether or not a person uses. In other words, holding craving constant, use is not inflexible, precisely because goal-directed behavior is sensitive not only to desire but to belief. Of course, people with AUD may have higher tolerance thresholds for alcohol-related risks and costs than people with no such diagnosis. But it cannot be that, in addiction, use persists when a person is palpably gripped by craving, *no matter what*. To think otherwise is to ignore the fact that, if drug use is explained by desire, then it is also explained by belief.

The tension in the operationalization of irresistibility such that it can be modeled in animals—and studied experimentally in rats and humans alike—derives from the fact that, if the behavior under investigation really is to be explained by belief and desire, then it is not inflexible. The basis for attributions of beliefs and desires to explain behavior—as opposed to habit or S–R responding—*is* behavioral flexibility consequent on interventions to manipulate either mental state. If changes in desire for an object, or in belief relating to the desired object, could not affect a subject's behavior, then we should be skeptical that the behavior should be explained by belief and desire at all. Hence, given their role in action explanation, we should be skeptical that desires could be irresistible. Of course, desires may be more or less strong. They may therefore weigh more or less in decision-making, and be more or less hard to resist for subjects, like humans, capable of resistance. But they are not forces of unstoppable strength, driving behavior forward like a train barreling down a track.

2.6 | Cravings and time

I conclude this section by considering a natural objection to the skeptical argument just presented. The objection may begin thus: Would the person with AUD in the hypothetical contingency degradation experiment not simply get up and find another bar? I do not deny that they

[11]It is of course possible that, in some cases, getting this information could serve to extinguish the craving altogether, or fail to result in a change of belief. Neither possibility impugns the hypothetical experiment, which is designed to probe a different kind of case: how a person with AUD might act when they continue to experience the craving while changing their belief.

likely would. The objection may then continue: Does this not mean that their craving is indeed irresistible, if we take a diachronic rather than a synchronic view of irresistibility? In other words, the person may not use *now*, but, assuming the craving persists, and no matter how much they try to abstain, they will, in all likelihood, use *eventually*. That is the nature of craving for drugs in addiction. It persists if unfulfilled and recurs if fulfilled. This means that, over time, use becomes, practically speaking, close to inevitable.

I do not wish to claim we can make no sense of an idea of the "irresistibility" of desire as the likely "inevitability" of acting on it over time.[12] Nor do I deny the likelihood that anyone with addiction, no matter how much they are trying to abstain, may well use again. Drug use is not, strictly speaking, inevitable. The majority of people who meet diagnostic criteria for a substance use disorder (SUD; the *Diagnostic and Statistical Manual 5th Edition* (DSM-5) category that maps onto addiction; American Psychiatric Association [APA], 2013) do eventually come to see themselves as recovered (Substance Abuse and Mental Health Services Administration [SAMHSA], 2023). But recovery is hard and far from guaranteed, with a high probability of lapses and relapses along the way. Hence the objection raises an important question: Granting that craving is not irresistible at a time, why do drug desires trend toward winning out over time?

In evoking the idea of diachronic irresistibility, the objection invites us to answer this question by returning to an image of craving as a force so strong as to be impossible to resist: as if cravings for drugs that are initially resistible build to a breaking point with time. We might again be tempted to invoke a physical metaphor: Think of water slowly amassing behind a dam before it bursts, or bladders and lungs slowly filling up before exploding. Not immediately, but eventually, the force is just too much to be contained. But this image is precisely what must be exorcised from our thinking. If it is indeed incorrect that drug use persists, no matter what, when a person is palpably gripped by craving, then the answer to the question of why a person eventually uses, over time, cannot be that they are palpably gripped by craving up to and including whatever time it is when they eventually use; for, at that time, when they use, their use is no more inflexible than it is at any other time. Hence, although time increases the likelihood of use, this cannot be because time transforms cravings that were once resistible into cravings that are now irresistible. The question therefore remains: Why do drug desires trend toward winning out over time?

Chandra Sripada's analysis of loss of control provides an answer (2018, 2022a, 2022b). Let us loosely define loss of control in addiction as using drugs despite either one's better judgment or a sincere intention to abstain. Sripada argues that loss of control is due, not to the *irresistibility* of desire, but to the *fallibility* of the cognitive systems necessary for behavioral control. Sripada begins by noting that cravings for drugs (alongside what he calls "distorted" thoughts about drugs; see footnote 13) occur with high frequency during addiction and in the early months of recovery. Abstaining from use therefore requires repeatedly exercising control over one's actions in the face of cravings. But exercising control is a multi-stage process with a "complex choreography", as he puts it, involving a cyclical procedure of monitoring, attending, reasoning, and revising. These processes are susceptible to brute error due to noise, indeterminacy, elements of randomness, and the limitations on resources that plague any cognitive system. Hence Sripada's analysis answers the question raised by the objection, without invoking diachronic

[12]Indeed, in absence of a requirement that "irresistibility" be applicable to animals who are incapable of metacognitive attitudes, there are a range of ways to try to elucidate the idea; for example, Mele (1990) argues that a desire is irresistible for a subject at a time if they do not have a *strategy* for effective resistance that meets a triad of epistemic, motivational, and agential conditions; Watson (1999), despite his skepticism at the idea of "irresistible" desires, nonetheless recommends a *normative* conception of "compulsive" desires that draws on resistibility. For Watson, a desire is compulsive if it is sufficiently strong that it is unreasonable to expect even a strong-willed person to resist it.

irresistibility. At least one reason why drug desires trend toward winning out over time is that the cognitive systems necessary for behavioral control are fallible: the more time, the more they must be exercised; the more they must be exercised, the more errors.

This section has been predominantly negative: an attempt to put the nails in the coffin of a false image of craving, and, in so doing, to draw some general lessons about the nature of desire based on its role in action explanation. But, notwithstanding its flaws, the image has tremendous pull. If only it were true, it would offer an elegant and powerful solution to the puzzle of addiction. But not only this. If only it were true, it would help mitigate responsibility for any wrongs associated with drug use in addiction, in virtue of offering a generic excuse. People with addiction would not be able to help but use drugs, for their cravings would be irresistible. In consequence, however convincing the arguments, the image may be hard to relinquish. My aim in Section 3 is predominantly constructive: to explain what, if not irresistible desire, craving is, and why it matters that we recognize it for what it is. I hope this positive account will help put to rest any remaining misgivings. But, in offering it, I do not pretend to thereby solve the puzzle of addiction or settle questions of responsibility for any wrongs associated with drug use in addiction. What I will say in my defense is simply that I do not believe this should be cause for regret. Addiction is complicated. People are complicated. Responsibility is complicated. We need to relinquish the image because it is false. But we should also be suspicious of any attempt to do so much with so little: to explain so much of addiction and answer so many serious questions of agency, responsibility, and morality, by appeal to something as simplistic as the supposed irresistibility of craving for drugs.

3 | THE HETEROGENEITY OF CRAVING AND WHY IT MATTERS

3.1 | The landscape of desire

Craving is predictive of use and relapse (Epstein et al., 2009; Preston et al., 2009; Serre et al., 2015; Suzuki & Kober, 2018; Vafaie & Kober, 2022). But craving is only one of a polythetic set of diagnostic criteria for SUD and neither necessary nor sufficient for diagnosis (APA, 2013). Not all people with addiction experience cravings (Bergeria et al., 2021); and some people experience cravings years into recovery when they do not meet diagnostic criteria for SUD (Robinson & Berridge, 1993). Meanwhile qualitative studies of craving are few and messy as people mean different things by the word. A study of 39 subjects with opioid use disorder identified eight distinct dimensions in response to the open-ended question "What do you mean when you say you are craving opioids?" including: anticipation of negative reinforcement (e.g., relief from suffering); anticipation of positive reinforcement (e.g., getting high); interfering thoughts; having a need; physical withdrawal symptoms; desire to use; lack of control over use; pain relief (Bergeria et al., 2021). No single dimension was identified by all subjects; answers varied with years in treatment, addiction severity, and race. So, to be clear, by "craving", I mean a kind of desire. But not all desires are cravings. I therefore begin with some general remarks about desire, to identify which are cravings.[13]

[13]Note that psychological states and processes other than desire may be equally important to understanding addiction (see, e.g., Bornstein & Pickard, 2020; Pickard, 2016, 2018, 2021). As noted in Section 2.6, Sripada (2022a) hypothesizes that "distorted" thoughts impair control in addiction alongside cravings. Sripada presents distorted thoughts as distinct from cravings; but thoughts can in theory be manifestations of desire, in which case, some distorted thoughts might also be cravings. This accords with how craving is defined in DSM-5: "an intense desire or urge" that can be manifest in "interfering thoughts" (APA, 2013, p. 483).

The landscape of desire is full of cross-cutting distinctions. Desires can be *standing* or *occurrent*. Standing desires are waiting offstage: not currently "playing a role in one's psyche" (Schroeder, 2020). Occurrent desires are currently playing a role in one's psyche, but this role varies; they may or may not be guiding behavior, just as they may or may not be conscious. Desires can be *for objects* or *to perform actions*. For example, you can desire *food*, or *to eat*. It is not obvious that desires, by contrast with wishes, can be straightforwardly directed at the past; but they can certainly be directed at either the present or the future. One can desire to eat *now*, or *later*. Desires can also be *intrinsic* or *instrumental*. One can desire an object or to perform an action *for its own sake*, or because it is a means to an end one independently desires. For example, you can desire to eat for its own sake, that is, just for the sake of eating; or because you desire to put on weight, and know that, to do so, you need to eat, hence, you desire to eat. Finally, some, but not all, desires are *appetitive*. Wayne Davis (1984) argues for a distinction between *volitive* and *appetitive* desires, marked (but not defined) by the difference between a subject *desiring* an object or to perform an action, and a subject *having a desire* for an object or to perform an action. For example, consider that you can desire to eat (because you need to put on weight) but not have a desire to eat (because you are not hungry); equally, you can desire not to eat (because you put on too much weight) but have a desire to eat (because you are hungry). Volitive desires are typically based on reasons, which can include having an appetitive desire, alongside all-thing-considered value judgments. Appetitive desires, by contrast, are not typically based on reasons. Rather, they view their object or the action to be performed with pleasure, in a general, inchoate way. What this means, at a minimum, is that (to return to Peter Railton's apt phrase) the object or action desired *beckons*. It does not mean that the object or action will in fact be pleasurable—nor even that the subject believes that it will. For example, you may have a desire to eat, but know it will not be pleasurable to eat, because you have toothache. Nonetheless, eating *beckons*.

Cravings for drugs are occurrent, present-directed, appetitive desires. They occur at a time or over a period of time. And they are directed (more or less) at the time when they occur. Cravings are for drugs or to take drugs *now* (or at least *very soon*). But they are now, at the time when they occur, *unsatisfied*. One can crave what one does *not* currently have or *more* of what one does currently have, but one cannot crave *only* what, at the time of craving, one already has. This may help explain their characteristic phenomenology. Because they are occurrent, present-directed, and unsatisfied, they capture attention (Watson, 1999), and have an immediate, felt, urgency (Wallace, 1999; Wonderly, 2021). Crucially, however, they can be either intrinsic or instrumental.

To see this point, consider the relationship between craving and withdrawal. Some but not all addictive drugs produce physical dependence, such that dose reduction or abstinence results in a characteristic set of physical withdrawal symptoms. For example, withdrawal from opioids typically lasts up to a week, and can include fever, nausea, diarrhea, aches, cramps, runny nose, watery eyes, insomnia, formication, and more. As this list attests, it is awful to experience. It is also relieved by taking opioids. It is often assumed that simply being in a state of opioid withdrawal therefore generates a craving for opioids. But it does not. People—and perhaps rats[14]—must learn through experience that taking opioids is a means to relieving opioid withdrawal. Evidence for this comes from the common phenomenon of "hospital flu". Patients who become physically dependent on opioids after taking them for pain relief in hospital may not know that

[14]As reported by Hutcheson et al. (2001); but see Shaham et al. (1996) for conflicting evidence suggesting that rats cannot learn to self-administer opioids to alleviate withdrawal at all.

they are. After discharge, they go into withdrawal, but they believe they have flu. They do not crave opioids. Now, if one tells such a person that taking opioids—or, indeed, taking any drug, whatever its nature—will alleviate their symptoms, they will typically desire to do so. They may, indeed, feel a kind of desperation to find and take the drug that they now know will help. This desire is generated by a process of instrumental reasoning. The person desires relief, they come to believe that taking the drug will bring relief, so they therefore desire to take the drug; the sense of desperation to find and take the drug is inherited from the desperation to feel relief. I do not want to claim that we would never call such a desire a craving—craving talk is loose. But it is importantly different from what we ordinarily mean by craving for drugs. The reason is that the desire is formed through instrumental reasoning as opposed to direct experience of the reward of taking an opioid when in withdrawal. To see this difference, suppose that, in the throes of withdrawal, the person gets hold of an opioid, and takes it. Doing so brings immediate relief. They now know, *from experience and for themselves*, what exactly taking an opioid will do for them—the relief that it will bring. Next time they are in withdrawal, they may therefore crave opioids—in the ordinary sense of craving for drugs.[15]

Desires can be generated by instrumental reasoning or learned through experience. Cravings for drugs are learned through experience. But, crucially, cravings that are learned through experience can be either intrinsic or instrumental. A person can crave drugs for their own sake; they crave *drugs*, simpliciter. But the person who craves opioids when they are in withdrawal because they know for themselves the relief opioids will bring does not crave opioids for their own sake, but because they are means to relieve the suffering of withdrawal. Hence, cravings for drugs are fundamentally a species of *learned desire*—but they can be either intrinsic (Sections 3.3 and 3.5) or instrumental (Section 3.4).

3.2 | Three kinds of craving

What is a craving for drugs a craving *for*? To take drugs, obviously. However, the object of a craving can have varying degrees of specificity. You can crave alcohol—or you can crave a perfect Manhattan, not a beer or a glass of red wine; amphetamines in general—or cocaine in particular; heroin—but not oxycontin. But a craving, however specific, may be satisfied (not just extinguished) by objects other than what the craving is for.[16] A craving for a Manhattan may be satisfied by a glass of red wine; a craving for amphetamines by heroin. We can individuate the object of a craving by appeal to the outcomes that will satisfy it, and lose the phenomenological specificity of the experience; or we can individuate the object of a craving by appeal to the phenomenological specificity of the experience, and lose the connection to the outcomes that will satisfy it. This quandary is not unique to craving for drugs but characteristic of many appetitive desires. I use the term "craving for drugs" loosely, to indicate an occurrent, present-directed, appetitive desire to take drugs, without resolving what precisely the object of any particular craving is.

Suppose we ask, of any individual, not *what* precisely they crave, but *why* they crave drugs at all. As Michael Smith (1998) notes, even if actions must be explained by belief–desire pairs, action explanation may be incomplete if we cite only a belief–desire pair. To make sense of the

[15]For a similar point, see Dretske (1988, 1990).

[16]Cravings can be extinguished without being satisfied, for example, perhaps by change in belief (see footnote 11) or by measures such as, for example, "urge-surfing", distracting oneself, going to sleep.

behavior, we may also need to explain why a person desires what they desire (or, for that matter, believes what they believe). In what follows, I suggest three kinds of answer to the question of why people crave drugs. Each answer can be understood as corresponding to a variety of craving, which I call cue-induced, goal-focused, and attachment-based, and which I illustrate using fiction and first-person testimony. These varieties are pragmatic, in the sense that they count as kinds in so far as they have value in explanation and, correspondingly, prediction and intervention (see Section 3.6). They may not be exhaustive; they are certainly not in all cases mutually exclusive; and I do not claim they carve the world at its joints. Human craving for drugs is therefore *heterogeneous* (Flanagan, 2020).

3.3 | Cue-induced craving

Drug cues are stimuli that have become associated with drug use through individual learning. They can be exteroceptive: people, places, paraphernalia, advertising. And they can be interoceptive: memories, moods, emotions, and physical states, such as, for example, withdrawal or drug priming. It is uncontroversial that drug cues can instigate drug-seeking and drug-taking. The controversial question is why. Lee Hogarth argues that drug cues do not cause habitual drug responding, but rather signal that a response has a higher probability than it otherwise would of securing drugs, thereby (potentially) initiating goal-directed behavior (Hogarth, 2020, 2022). Belief that drugs are available may, of course, lead to craving. Smokers on short and long flights alike only develop cravings at the end of the trip, when they believe it will soon be possible to smoke—notably, given the difference in length of forced abstinence, their cravings are of similar strength (Dar et al., 2010). Similarly, satisfaction of craving may depend on believing that a drug has been consumed, not just consuming it. After smoking a nicotine cigarette, smokers report craving is satisfied only if they also believe the cigarette is not a placebo (Gu et al., 2016). By "cue-induced craving" I do not simply mean craving in some way caused by cues; cues can no doubt cause goal-focused or attachment-based craving. I mean the explanation of craving provided by a particular theory of addiction: the incentive salience theory initially advanced by Terry Robinson and Kent Berridge (1993).

The incentive salience theory claims that craving is caused by neuroadaptations to the mesolimbic dopamine system. This system is hypothesized to imbue stimuli and behavior with "incentive salience". This means, quite simply, that they capture attention and become desired. Many classes of drugs enhance dopamine transmission. The incentive salience theory states that long-term immoderate drug use can therefore cause the mesolimbic dopamine system to become hypersensitized to drug-associated stimuli and behavior, transforming ordinary desire into intense craving when cues are present (or indeed merely imagined). Crucially, this hypersensitization occurs independently of the neural systems mediating positive and negative reinforcement, in other words, independently of any rewarding outcome of drug use, such as pleasure, or relief from suffering, such as caused by withdrawal. As Robinson and Berridge colloquially put the point, "wanting" drugs can come apart from "liking" them. Hence, the answer provided by incentive salience theory to the question of why an individual craves drugs is that neuroadaptations cause hypersensitization to drug cues leading to craving that is excessive and—this is key—not to be explained instrumentally (by recourse to what drugs do for a person, e.g., bring pleasure, or relieve suffering) or expressively (by recourse to what drugs mean to them, more on which below, see Section 3.5). In other words, the explanation of drug craving is not a psychological explanation. It is a neurobiological explanation.

The incentive salience theory therefore shares something important with the habit theory. By contrast with the habit theory, drug use is explained by desire. Drugs *beckon*. But there is yet a kind of mindlessness. Cue-induced craving for drugs is, in effect, *psychologically* inexplicable. There may be no purpose in drug use, nothing for which it is done or that it means. Cue-induced craving is, in its purest form, a "bare" desire: a desire to take drugs, for the sake of taking drugs, *nothing more*. As emphasized in Richard Holton and Kent Berridge's co-authored work (2013), it is therefore an intrinsic desire. Indeed, it is, in a sense, the pinnacle of all intrinsic desires. In theory, there may be no real or anticipated reward in taking drugs at all, apart from the "bare" reward of doing what is desired. Hence, from a psychological perspective—whether that of an observer or the person whose craving it is—cue-induced craving for drugs has no explanation. To explain why an individual craves drugs, we appeal not to their mind, but their brain.

In consequence, cue-induced craving is well positioned to explain something important about some people's lived experience of addiction (Robinson & Berridge, 1993; Holton & Berridge, 2013). Namely, the experience of not making sense—*to oneself*. Consider Owen Flanagan's poignant description of his own addiction in his classic paper "What is it like to be an addict?": "I wanted not to use, I expressed to myself, my loved ones, and to mental health professionals a sincere desire not to use, and I used. Again and again. P & -P" (2011, p. 270). I take the metaphorical "P & -P" to express more than the familiar conflict between appetitive desires and volitive desires or all-things-considered value judgements. Ordinary conflicted subjects do not typically struggle to understand why they desire the thing that their better judgment counsels against. I take it to reflect something about the incoherence, the unintelligibility, to Flanagan himself, of his craving for drugs. Drugs beckon—but, at least for some periods of his addiction, there is nothing he can say about why they beckon. In this light, consider the following quotation from Tove Ditlevsen's autobiography, which powerfully illustrates her experience of and alienation from cue-induced cravings during her recovery from opioid use disorder:

> Then my attention was suddenly caught by a well-lit pharmacy window. It radiated a muted light from the containers of mercury and beakers filled with crystals. I kept staring there, while the yearning for the small white pills, which were so easy to get, rose inside me like a dark liquid. Horrified, I realized while I stood there that the longing was inside me like rot in a tree, or like an embryo growing all on its own, even though you want nothing to do with it (Ditlevsen, 2021 [1971], p. 356).

It is a virtue of incentive salience theory that it can help explain this experience of *self-opacity*. But it is not everyone's experience—nor even, as Flanagan and Ditleven make plain at other points in their writings, their experience at all times.[17]

3.4 | Goal-focused craving

Step back from craving for a moment. Suppose we ask, not why an individual who is addicted to drugs craves them, but why anyone takes drugs at all. Although it can take time to learn to

[17]Flanagan emphasizes how drugs give him an experience of safety—release from life-pervading fear and anxiety; for Ditlevsen, they give a kind of peace—an escape from an inner emptiness and inchoate sense of unfulfilled need. Many addiction memoirs emphasize similar experiences; see, for example, Grisel (2019), Knapp (1996), and Szalavitz (2016).

enjoy and appreciate drugs (Becker, 1963; Zinberg, 1984), they are a reliable source of pleasure for many users, non-addicted and addicted alike. But drugs serve other well-known and well-documented functions too (Müller & Schumann, 2011). These include relief from pain, fatigue, stress, boredom, negative affective states, and suffering; improved physical energy, cognitive ability, social connectedness, social interaction, and sexual experiences; novel, spiritual, mind-altering, and self-altering experiences; and, drawing on memoirs, to this we might add feelings of safety, security, control, power (see footnote 17; see also Lavallee, 2020). Different drugs serve different of these functions. Opioids are bliss, and relieve pain and suffering; amphetamines are thrilling, and boost cognitive ability; alcohol and benzodiazepines are relaxing, loosening social inhibitions, relieving anxiety, creating a sense of safety; ecstasy brings a glow that heightens social connectedness; psychedelics blow our minds, producing transformative experiences people describe as some of the most meaningful of their lives (Belser et al., 2017; Noorani et al., 2018). Unsurprisingly, given this panoply of functions, different people use different drugs in different circumstances and for different purposes. A study by David Epstein and colleagues (Epstein et al., 2009) provides a striking illustration of this point. People with polydrug addictions differentially crave and use cocaine and heroin; cocaine is linked to good mood and good news, while heroin is linked to sadness, anger, and bad news. Why? Because cocaine is thrilling—a party drug—and opioids are comforting—a panacea for negative emotions, pain, and suffering. Indeed, even rats select different drugs in different environments, preferring heroin in home-cage and cocaine in non-home-cage contexts (Ahmed et al., 2020; Badiani et al., 2011). But, nuances aside, the key point is that drugs have tremendous value to people because of what they do for us. Taking drugs is a means to satisfying many ordinary yet powerful desires. And, crucially, drugs do not stop fulfilling these functions and so satisfying these desires—even if the intensity of pleasure may be reduced through tolerance—in addiction. The experience of taking drugs can be extraordinarily rewarding. Whether the reinforcement is positive or negative, *drugs can transport us to a better place*.

Goal-focused craving is a desire to take drugs in order to experience this psychic transportation—in any of its various forms. Craving drugs in the throes of withdrawal is one kind of goal-focused craving. As noted above, although such craving is not generated through instrumental reasoning, it is, like all goal-focused craving, nonetheless an instrumental desire: stemming from the experience of learning from one's own case what drugs can do. But, although opioid withdrawal provides an elegant and much-studied example of goal-focused craving (Koob, 2020), it is important to acknowledge both the many forms of positive reinforcement, and the other forms of negative reinforcement, equally offered by drugs in addiction. It has long been recognized that addiction is strongly associated with co-morbid mental disorders, socioeconomic disadvantage, and social isolation (Alexander, 2018; Compton et al., 2007; Heyman, 2009; Maté, 2009; Regier et al., 1990)—all of which are linked to tremendous stress and negative affective states. As Lee Hogarth (2020, 2022, see also Hogarth et al., 2018) documents, addiction severity is mediated by self-reported use of drugs to cope with negative affective states in vulnerable groups. One of the most obvious reasons why many people with addiction crave drugs is that they consciously use them to escape from a life of misery and suffering (which extends far beyond the physical state of withdrawal) and to achieve not only relief, but feelings of comfort and peace, exhilaration and joy. In this light, consider this passage from Barbara Kingsolver's novel *Demon Copperhead*:

> If you've not known the dragon we were chasing, words may not help. People talk of getting high, this blast you get, not so much what you feel as what you don't; the sadness and dread in your gut, all the people that judged you useless. The pain of an exploded leg. This tether that's meant to attach you to something all your life, be it home or parents or safety, has been flailing around unfastened all this time, tearing at your brain's roots, whipping around so hard it might take out an eye. All at once, that tether goes still on the floor, and you're at rest (Kingsolver, 2022, p. 470).

But, whatever the precise goal, given that taking drugs is a means to satisfying many ordinary yet powerful desires, the explanation of why an individual craves drugs is often psychologically straightforward. They crave the psychic transportation that they know, from experience, taking drugs can provide.

3.5 | Attachment-based craving

The final explanation of why individuals crave drugs is that drugs are a deep and meaningful part of their life, like an old friend or a lover to whom, as Monique Wonderly (2021) has argued, they are attached (see also Watson, 1999). As illustration, consider how Cheryl Strayed expresses her relationship to heroin, the drug that helped her escape the pain of her mother's sudden death:

> Heroin was different. I loved it. It was the first thing that worked. It took away every scrap of hurt that I had inside of me. When I think of heroin now, it is like remembering a person I met and loved intensely. A person I know I must live without (Strayed, 2000; quoted in Pence, 2020, p. 1).

Similarly, Hank, one of the men depicted in *Righteous dopefiend*, Philippe Bourgois and Jeff Schonberg's ethnography of homeless polydrug users (2009), describes his relationship with heroin thus:

> You know how when you're walkin' and you look up and across the street and you see someone you think you know? And then you walk closer, and it turns out to be an old friend, someone you used to kick it with as a kid. And you walk up to each other, and you each ask how the other's doing. And you talk for a while. And then you leave, saying to yourself, "Wow! It was really good to see him." That's what heroin feels like to me (Bourgois & Schonberg, 2009, p. 80).

Bourgois and Schonberg (2009) note that the men they speak with are not embarrassed by lack of sexual and romantic relationships, typically cutting short conversation with a common refrain: "My old lady is heroin and I been faithful to her for over twenty years. I've never cheated on her, and I never will" (p. 96).

For some people with addiction, their relationship with drugs is akin to a relationship with someone they love and care for. Of course, there are differences. Drugs cannot love them back, and no one cares for drugs *for their own sake*, in sharp contrast with how we care for other people. But, as Wonderly notes, we *need* the people to whom we are attached. They provide us with a sense of security and make us feel stable and safe in the world. And this can be true of

drugs. Indeed, a person's relationship to drugs may be the most important such relationship they have—drugs may be the one thing that has never let them down. In consequence, the possibility—let alone actuality—of abstinence is daunting, disorienting, unmooring; it is a cause for grief. Craving for drugs can therefore be an affirmation of the meaning of this relationship, expressing a need stemming from attachment and its consequent, the fear of loss.

But drugs may not only provide a sense of security. They may in addition provide a sense of self and social identity (Pickard, 2021). Try to imagine, however briefly, what it might be like to be and to identify as being an "addict". Your daily routines will revolve around getting and using drugs. Many if not most of the people you spend time with will use drugs. Drug use will be one of the defining features of your life if not *the* defining feature. Indeed, drug use is a significant part of what defines *you*. That is what it is to identify as an "addict". For people whose attachment to drugs is not only security-based but identity-based, the possibility of abstinence represents not just a cause for fear and grief, but an *existential threat*. What will life be—*who will they be*—without drugs? Craving for drugs can therefore also be an affirmation of identity—the expression of a desire to live in accord with one's sense of who one is.

Attachment-based craving is the polar opposite of a psychologically inexplicable drug desire. Indeed, it goes to the very heart of human psychology. But, crucially, it is not an instrumental desire. An important feature of goal-focused cravings is that they make drugs *replaceable*—if, that is, another means to satisfying the desire can be found (see below, Section 3.6). Suppose this to be the case. Suppose that a person for whom drugs provide, say, a feeling of safety or relief from suffering, finds another way to achieve this. If they are, in addition, attached to drugs and a life of using—if their relationship with drugs is a deep and meaningful part of their life and identity—then, even if they opt to replace drugs with this alternative means of safety and relief, we would expect them to grieve, to yearn, to crave what they have lost, to crave to be who they were once again. This is because their relationship to drugs is not just based on what drugs instrumentally do for them. It is based on what they intrinsically mean to them. Quitting, even if rational, is "heartbreak" (Lewis, 2015, p. 74; quoted in Wonderly, 2021, p. 172). Attachment-based cravings are intrinsic desires—like cue-induced cravings. But, unlike cue-induced cravings, they are perfectly psychologically explicable.

3.6 | Why it matters

Let us return to where we began. Suppose the craving for drugs in addiction really was irresistible. What then should we do to address addiction? There are two obvious solutions. The first is supply restriction. *Make it the case that there are no drugs to be found*. The prohibition and criminalization of the possession of many classes of drugs attempts just this. It is not a successful strategy. Putting aside questions of injustice, it fails practically (Earp, Lewis, Hart, & with Bioethicists and Allied Professionals for Drug Policy Reform, 2021); in all likelihood, there has never been a society that did not use drugs (Slingerland, 2021). The second is restriction of freedom. *Make it the case that people with addiction have no access to any drugs that can be found*. In other words, the solution involves confinement of people addicted to drugs, whether in prisons or treatment centers. This strategy also fails. Drugs pervade many prisons (and some treatment centers). Meanwhile, you cannot—for practical reasons, let alone questions of justice—confine people indefinitely to stop them from using. Yet despite their evident failure, both strategies remain dominant.

There are many reasons to fight against drug criminalization and the confinement of people with addiction—apart from their alliance with a false image of craving (Earp, Lewis, Hart, &

with Bioethicists and Allied Professionals for Drug Policy Reform, 2021; Husak, 2002; Pickard, 2022). The point I want to emphasize here is that adherence to these strategies speaks to the influence of this image. Fundamentally, these strategies are *controlling*. They control supply, they control people. And, even if the false claim that cravings are impossible to resist is softened to the true claim that they are hard to resist, this emphasis on control often remains—not now of supply or people, but of desire itself. This is evident in the persistent focus by addiction science and its funding bodies on the search for pharmacotherapies to block the generation of cravings (Hogarth, 2022); and in a corresponding clinical focus not just on the prescription of pharmacotherapies but on the improvement of the capacity for behavioral control (through, e.g., mindfulness, techniques for self-regulation such as "implementation intentions", "stop and think" cognitive therapy, and, ultimately, willpower)—so that a person is better placed to deal with any cravings that might escape from the headlock of pharmacotherapy. In other words, at least in some jurisdictions, a standard treatment plan is to use drugs (the good ones) to control the desire for drugs (the bad ones). And if (the good) drugs fail, we try to get people to control their desires for themselves.

Lest I be misunderstood: Pharmacotherapies that help—which many do—should be unconditionally offered. These include, among others, nicotine patches for nicotine addiction, and methadone, buprenorphine, and even injectable heroin (in refractory cases) for opioid addiction (Strang et al., 2015). Equally, all tips, tricks, and therapeutic interventions that help people develop better control over their drug use should be deployed. My point is not to suggest we *restrict* interventions that could help, like pharmacotherapies and techniques to improve control, *but to expand them*. This is how to put to the heterogeneity of craving to work.

Of the three varieties, cue-induced craving is most at risk of invoking the image of irresistibility. This is for two reasons. First, and most simply, its label. Phrases like "cue-induced" and its cognates, such as "cue-driven" or "cue-reactive", sound deterministic. Second, the *mindlessness* of this form of craving that I argued was in fact a virtue—in so far as it explains the self-opacity that people with addiction sometimes experience. But, crucially, incentive salience theory has never claimed that cravings are unstoppable (Berridge, 2017, 2022; Holton & Berridge, 2013)—only that hypersensitization of the mesolimbic dopamine system is a good explanation for why drug cravings are strong in the face of drug cues. Proper appreciation of the theory therefore invites two kinds of intervention. First, the social regulation of drug cues, through advertising, packaging, and control of outlet density (Hogarth, 2022). All too often, avoiding cues is left up to people with addiction themselves; for example, consider the injunction "don't go to the pub". Good advice, but hard to take in our drug-obsessed society. Much more could be done to limit cue exposure. Second, the necessity of offering CM treatment—especially therapeutic workplaces—as well as ensuring what social justice anyhow demands, namely, fair distribution across all strata of society of the opportunity to avail oneself of alternative reinforcers, such as, for example, education, employment, social belonging, or what has aptly been termed "a stake in conventional life" (Pickard, 2020; Waldorf et al., 1992). We can address cue-induced craving by the provision of meaningful and competing alternative rewards (Acuff et al., 2019; Banks & Negus, 2017; Hogarth & Field, 2020). That is the bottom-line lesson of Section 2 and its consideration of animal models of addiction. Rather than try to control cravings for drugs, we can instead intervene to create and support alternative desires, goals, and opportunities—things that give life meaning and purpose.

Next, consider goal-focused craving. If people crave drugs instrumentally, because of what they do for them, then rather than try to control drug desires we can try to find replacements that serve the same ends. This strategy has two steps. First, identify what drugs are doing for a

person. Sometimes this is obvious. For example, when drugs are staving off withdrawal, or when people self-report using to cope with negative affective states. However, in other cases, it is not. Insight into what ends drugs serve can be difficult to come by—especially, perhaps, if drug use is a source of shame (Flanagan, 2013)—requiring not simply introspection, but soul-searching. Lack of insight into goal-focused craving is therefore an important alternative to cue-induced craving as an explanation of self-opacity. Second, find a replacement that serves the same end. For example, if drugs are being used to stave off opioid withdrawal, try methadone; if drugs are being used to cope with negative affective states, try alternative strategies, like developing techniques for emotional regulation, talk therapies, forms of self-care, and peer-to-peer or group support. In addition to lack of insight, barriers to such two-stepped management plans can be practical, such as lack of access to pharmacotherapy or talk therapy; they may also include the difficulty of finding alternatives as effective as drugs. Nonetheless, the basic method to address goal-focused craving is, in theory, straightforward: Figure out what exactly drugs are doing for a person and find something else to do it instead.

Finally, consider attachment-based craving. One of the many puzzling features of addiction is that relapse can occur long after abstinence has been achieved. Lasting neuroadaptations to the mesolimbic dopamine system offer one explanation (Holton & Berridge, 2013; Robinson & Berridge, 1993). Attachment-based craving offers another. If one's relationship with drugs is a deep and meaningful part of one's life, like a friend or a lover, then they are irreplaceable. That is what it is to be attached. Imagine if you could once again see a person whom you loved and lost years after the rupture. Even if you decided on balance not to re-open that relationship, wouldn't the pull to do so be strong? There are moments in all our lives when relationships and related identities we have cast away still call to us—even if on balance we do not want to reinhabit them. Here is Caroline Knapp, in her memoir *Drinking, a love story*, making just this point:

> I once heard a woman say that as an alcoholic, a part of her will always be deeply attracted to alcohol, which seemed a very simple way of putting it, and very true. The attraction—the pull, the hunger, the yearning—doesn't die when you say good-bye to the drink, any more than the pull toward a bad lover dies when you finally walk out the door. (Knapp, 1996, p. 268)

As Doug McConnell has argued together with Anke Snoek, to successfully recover and resist relapse requires a kind of *narrative work* (McConnell, 2016; McConnell & Snoek, 2018). It is not always sufficient simply to stop using drugs and create a new life structured around activities, projects, and relationships that do not involve drugs. People with addiction may also need to find a way to tell a life story that makes sense of the depth of this transition, in order to stabilize their new life and protect them from the pull of the past. But, crucially, the authenticity and credibility of this narrative will be greatly enhanced if it is embraced and validated by others. There are in consequence two simple ways to help people who experience attachment-based cravings quit and not relapse. The first is to acknowledge the depth of their relationship with drugs, making space for the reality of attachment and loss. This will not make cravings abate. But support and validation can make difficult experiences more bearable for us all. The second is to offer ourselves for relationships and make our communities places of compassion and welcome. Many people with severe addiction will have lost friends and family, and may find themselves socially isolated, ostracized from "conventional life" (Waldorf et al., 1992). Indeed, that may be part of why their relationship with drugs became so important.

If cravings for drugs are not irresistible, then they do not, by themselves, offer an elegant and powerful solution to the puzzle of addiction; nor do they straightforwardly excuse from responsibility for any drug-associated wrongs. No doubt they are part of the story—but they cannot be all of it. This, however, is nothing to lament. Addiction is heterogeneous; there are many different ways to solve its puzzle (Bornstein & Pickard, 2020; Pickard, 2016, 2018, 2020, 2021, 2022). Similarly, responsibility is complicated; there are many different reasons why responsibility might be beside the point, reduced, removed, or reimagined without stigma and blame in addiction (Pickard, 2017). Meanwhile, the image of craving as a force of unstoppable strength of which so-called "normal persons" can form no conception is, at bottom, dehumanizing. It invites us to see people with addiction—and for them to see themselves—as possessed by an alien force they are incapable of resisting and hence as something to be controlled. The image invites us, in other words, to adopt an extreme form of what P.F. Strawson called *the objective stance*: to see those with addiction as "to be managed or handled or cured or trained; perhaps simply to be avoided" (2008 [1962], p. 9). I have argued that this image of craving is false; seen in this light, it is also craven. Abandoning the image, and instead asking why people crave drugs, enables a range of explanations to come into view—from neurobiological through to ordinary full-bloodedly psychological—thereby expanding possibilities for intervention, providing grounds for connection, and rendering the desire for drugs despite their harrowing consequences more, rather than less, imaginable and intelligible. It enables us, in other words, to recognize those with addiction for who they are, one of us.

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