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Drug Dependence: Myth or Motive?[1]

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FALK, J. L. *Drug dependence: Myth or motive?* PHARMACOL BIOCHEM BEHAV 19(3) 385–391, 1983.—The acceptability of nonmedical use for a particular drug is a function of diverse social needs. Drug dependence is due less to intrinsic effects than to the situation in which drug taking occurs. An addictive level of drug self-administration is a symptom of behavioral troubles rather than a definition of the trouble itself. The intrinsic effects of drugs do not in themselves produce either misuse or evoke specific kinds of behavior such as sexual or aggressive activities. Drugs can, however, come to function as discriminative stimuli for socially sanctioned behavior that would not under other circumstances be tolerated. The intrinsic reinforcing potential of an agent evolves in and dominantes situations in which other reinforcing opportunities are either absent or remain unavailable to an individual who is unprepared to exploit them. While certain intrinsic properties of a drug contribute to its potential as a reinforcer (e.g., rapid onset and brief duration of action), reinforcing efficacy is notoriously malleable. It is a function of historic and currently-acting factors, particularly social reinforcers. The importance of physical dependence in the maintenance of drug seeking and taking is mainly unproven and probably overrated. Situations under which important reinforcers are available only in small portions intermittently can induce various excessive activities, including an untoward concern with obtaining and using drugs. Drug dependence prevention as a species of environmental dependence can be best effected by either alterations in the intermittent reinforcement situations inducing excessive behavior or by providing opportunities and training with respect to reinforcing alternatives other than drugs.

Drug dependence Adjunctive behavior Drugs and sexual behavior Drugs and violence Drugs and culture

RUDOLF Virchow, the 19th century German medical microscopist and father of the discipline of pathology, insisted that a disease is not a general affliction of the body, such as a humoral imbalance, but a localized, anatomical disturbance. The pathologist was to hunt for the seat of the disease, its locus. Consonant with the search for the place where critical events occur as the first step in delineating any mechanism of action, it would be convenient to be able to specify the locus of drug dependence. Alas, it has no simple locus. It used to be regarded as a function solely of the drug agent. An innocent, upstanding individual could become dependent even from unwitting contact with an enslaving agent. In the late 19th century in this country, there was concern that drug use could have an enervating effect on indulgers, lowering society's productivity [34]. The belief that in this land of opportunity prosperity was actually attainable, when coupled with the Victorian fear that one's personal energy stores might not be equal to life's tasks [43], led to apprehension that society's progress, as well as one's personal ambitions, might be compromised by the drain on energies produced by involvement with drugs. Opiates were viewed as enslaving the individual more because they produced debilitation and passivity rather than for their drug-taking, motivational aspects. The concern was with enervation ("nervous wasting") as the key toxic consequence for a society valuing vigor and fearing the dreamy disconnection of the user. "In the largest sense, whatever the controversy over its excessive use, alcohol appeared more suited than opiates to the American experience. Alcohol represented external action, competition, manliness, and strength. Opiates appeared defeatist, introspective, unnatural" [34]. In comparison with this picture, coca and cocaine "originally seemed attractive to sensitive and intelligent people seeking to maintain energy in order to work harder at socially acceptable tasks. Early users warned of its attractions to people seeking escape, but by and large saw it as a restorative" [34].

Whether a drug, then, is perceived as a social danger or help depends upon the putative behavioral effects of the drug, especially as these relate to behavior the society either encourages or finds reprehensible. But do drugs have intrinsic behavioral actions? Unless we are talking about large doses of anesthetic or convulsant agents I think that recent research in behavioral pharmacology, epidemiology, and cultural anthropology indicates that the behavioral effects of drugs are quite malleable. They do not simply release different behavioral actions such as aggression, fear, psychosis, sexual activities, euphoria or even religious revelation. As variability in the behavioral effects produced by many drugs became evident, both in their immediate effects and with respect to whether exposed individuals became dependent upon them, it was said that people responded to drugs differently depending upon what sort of persons they were. That is, personality and genetic differences were seen as the major factors accounting for behavioral differences in response to drugs. These variables, like the previous notion of the intrinsic behavioral action of drugs, are located inside the skin. While there is no reason to doubt that individual differences can affect drug response, analysis in these terms has not

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explained much about human drug-related behavior. These factors do not seem to account for much of the variance. There has been a long and mainly fruitless search for the "addictive personality" [29]. Heavy involvement with drug-taking is certainly correlated with behavioral troubles. But the cause-effect relations are not at all clear, and there is little reason to maintain that drug overindulgence lies at the root of the troubles. Negative consequences, often thought to be attributable to drug abuse, such as unemployment and dropping out of school, are consequences which exist independently of drug use and are highly correlated with social class [27]. As Robins and her associates [39] cogently point out: "People who use heroin are highly disposed to having serious social problems even before they touch heroin. Heroin probably accounts for some of the problems they have if it is used regularly, but heroin is 'worse' than amphetamines or barbiturates only because 'worse' people use it." We fasten on a drug such a heroin as central to a complex of social problems because it is an isolable substance, a material with all the cachet of the immediate and concrete. But crushing its use may be unproductive, for it is off the point. As society's agents, we may be behaving like the drunk who searches for his lost key under the street lamp because that's where the light is. Perhaps we are attempting to work on a complex social problem by getting at the heroin supply or blocking its effects in the user or assuming it has an isolable, reductionistic, disease-like, neurochemical basis. But drug dependence, as Laurie [30] remarks, "is a symptom and not a disease."

Let us return to the notion that drugs of abuse have intrinsic biobehavioral actions, and that these actions, working within susceptible individuals, are the processes out of which drug dependence is built. First, a study of drug usage by a large sample of young U.S. soldiers returning from Vietnam showed that while less than 1% had ever been addicted to narcotics prior to their arrival in Vietnam, about 20% became addicted there, but showed a surprisingly high remission rate after returning to the U.S. [38]. Narcotic usage and addiction fell to essentially their low, pre-Vietnam levels. This result stands in marked contrast to the extremely high relapse and readdiction rates of the populations usually studied in this country: those coming to legal or medical attention. These latter groups give the impression that opiate addiction is persistent, almost to the point of irreversibility, owing to the drug's intrinsic, addictive action. The heroin available in Vietnam was inexpensive, plentiful and of high purity. The users were susceptible in that they were quite young, free of their usual societal constraints, had peer-group acceptance for usage, and were subjected to the chronic boredom and stresses of a war theatre. Yet the ready reversibility of the addiction indicates that the abuse susceptibility resided primarily in the use situation rather than in the interaction of a prone or sensitive user with a fatefully entrapping substance.

A second line of evidence on the diveristy of heroin use patterns comes from the studies by Zinberg and his colleagues on nonaddictive opiate use [52]. These drug users were located through advertisements in the underground press, through universities and a variety of social service agencies, rather than because they had come to legal or medical attention owing to their use of drugs. Ninety-nine controlled-drug users were located and about half of these were opiate users. They maintained regular ties with work, school and family as well as ordinary social relationships with non-drug users. At the time of the study, the mean length of time of controlled use for the heroin users was 3.6 years, with stability of the use patterns. Drug use for these subjects occurs mainly within controlled-use groups, with solitary use being rare. For example, subjects might use heroin with friends every weekend, but more frequent use would be condemned as "junkie"-like. Addictive dependence was avoided. Long-term, moderate use patterns are possible under rather ordinary circumstances for a drug such as heroin, even though it is associated with a notable addiction liability. Apparently, the rituals and social sanctions against addiction and compulsive use within controlled-use groups are sufficient to prevent the occurrence of abusive patterns. As is the case with most social drinking, repeated commerce even with a substance having strong pharmacological action and an addictive hazard by no means implies a fatefully escalating motivational destiny. Exposure to a drug is one thing, while the development and maintenance of a pattern of abuse is something else. Robins' epidemiologic study of returning Vietnam veterans and Zinberg's case studies of controlled users indicate that sustaining an addictive pattern of behavior requires not so much a strong agent and a pliant host as it does a facilitating environmental setting. This can take a variety of forms, so let us examine a third example: the stereotypical "drunken Indian."

As MacAndrew and Edgerton [32] point out in their painstaking analysis, the conventional wisdom has it that while the Indians of North America craved the white man's liquor they were intrinsically sensitive to it in a way that made them react in a most aggressive and degenerate fashion. The chronicles of traders and missionaries yield numerous accounts of mayhem and debauchery. However, these kinds of extreme reactions by Indians to alcohol were neither typical nor were they characteristic of their early contacts with the substance. How, then, did the dramatic reactions to alcohol develop which, although by no means universal, were severely disruptive? MacAndrew and Edgerton [32] indicate that "the traders recognized that alcohol was potentially the most potent trade-ware in their inventory, for unlike iron skillets, hatchets, etc. (the demand for which was clearly limited), they saw that if a desire for alcohol could be created it would be insatiable. They recognized, too, that if such a desire could be made strong enough, then they, who alone could satisfy it, would be able to assume near-dictatorial control . . . every conceivable form of deceit and coercion was employed in forcing liquor upon the Indians" (pp. 114–115). Still, the use of liquor was slow to develop and failed to yield a picture of intemperate craving coupled to bad behavior at that stage. Clearly, no innate sensitivity or attraction was involved [31]. But along with the liquor the traders also offered a model of violent and immoral drunken comportment. This pattern was taken over and became an excuse for doing things that ordinarily would have been subject to punishment. It was simply claimed that liquor caused an evil spirit to possess the individual. Even feigning intoxication in order to do things that would ordinarily be punishable became common, a contemporary maneuver not confined to native North Americans. There were several ways, then, in which the altered economic and social environment of the Indian fostered the heavy use of alcohol, provided violent and destructive models for drunken comportment and reinforced these kinds of behavior. We have no need to posit an intrinsic sensitivity and attraction to alcohol to give a plausible account of the development of problematic overindulgence.

Psychoactive drugs are complex, but they do have dis-

cernible, specific effects. The question, in behavioral terms, is whether abuse liability is built from one or more intrinsic, specific effects. The reinforcing properties of drugs have been attributed to a varied list of reputed behavioral properties. Abused drugs have been said to release tension and, on the other hand, to effect a psychic activation. Some are touted as anxiety reducers and others as euphoriants. Many are taken because they are supposed to enhance already pleasant activities, such as listening to music, sexual, or just plain social interactions. Almost any commonplace or quasi-magical behavioral effect one could desire is envisaged as having some agent, or subtle blending of agents, that will bring forth the required behavior or psychic experience. Reluctantly we must leave aside for our present purpose the question as to how or whether drugs can actually effect these wonders. We will question, however, how specific the behavioral effects of drugs are and in what sense the powerful reinforcing effects of drugs are intrinsic actions. These two, interrelated questions bear upon the sources of dependence in drug dependence.

In questioning whether a drug has a specific behavioral action, what is meant is: Does the agent either release some category of behavior, or at least strongly dispose the organism in a specific behavioral direction? As a concrete example, let us ask whether the conventional wisdom about the behavioral effects of alcohol is the case: Does it increase sexual and aggressive kinds of behavior? The common assumption is that, owing to its disinhibiting effects, carnal and pugnacious impulses, usually held in careful check, are released by alcohol. The superego is said, only half jokingly, to be soluable in alcohol. In surveying a number of South American tribal societies, MacAndrew and Edgerton [32] find some slight support for our conventional wisdom. The Abipone change from their typically calm and nonargumentative demeanor into vicious combatants with one another during a drinking party, confirming the disinhibition notion. But by far most of the evidence offers no confirmation. The warlike, head-hunting Yuruna only become withdrawn when they drink. The Camba of Bolivia studied by Heath [22] show neither aggression nor sexual license during their frequent social binge-drinking bouts. Nor does alcohol addiction occur in spite of frequent binging with their distilled product, which is undiluted 89 percent ethyl alcohol. The Aritama are a quite rigidity controlled and formal people by our standards, perfect subjects for alcohol to effect a disinhibiting release upon. But they drink "without becoming aggressive, sentimental, verbose, or amorous" [32]. Examples from other societies in Mexico, Micronesia, and Japan are given by MacAndrew and Edgerton [32] in which drunken disinhibition ought to occur since they are either puritanical or repressive. But the expected drunken aggression and sexuality fails to materialize. "Indeed, the only significant change in comportment reported for any of these societies is an increased volubility or sociability" (p. 36).

Recent extensive reviews of the experimental literature on the effects of alcohol on human sexual and aggressive behavior [5,50] lead one to draw the conclusion that the coventional wisdom makes a statement about the behavioral consequences of drinking within several Western societies. The statement is that "the circumstances of drinking produce greater changes in behavior than the alcohol does" [5]. So much for the much-vaunted intrinsic effect of ethanol on aggressive and sexual activities.

Perhaps alcohol is a special case. Maybe its rather nondescript chemical structure and the probable absence of specific receptors for alcohol make it an unlikely candidate for producing intrinsic, specific effects. It is worth examining another agent. There is evidence for a phencyclidine/sigma "opiate" receptor in rat cortex and hippocampus [37]. Phencyclidine (PCP), a drug with a notable abuse liability, is associated with a varied set of behavioral effects [1,36]. Its reputation for producing violence has received a good deal of attention in the mass media, particularly on television specials. In assessing the potential of PCP for producing violence, it is necessary to consider carefully the user and the social circumstances of its use. Violent behavior in connection with PCP use occurs upon a personal and social background and out of situational events. As Siegel [41] remarks: "Phencyclidine is not a magical drug. It does not magically produce violent, assaultive, or criminal behavior." Investigation of aggressive behavior on a PCP detoxification and rehabilitation unit, compared with a herion unit, found similar low levels of violence [28]. An ethnographic study of PCP use in four American cities revealed violence to be rather rare, appearing mainly in members of groups where fighting resolved conflicts and asserted status [14]. Physical restraint and other kinds of authoritative intervention also can trigger a reactive violence [14,41]. PCP is an hallucinogenic drug with some amphetamine-like properties. As was the case for alcohol, its chemical properties and the social context of its use to a large extent determine its behavioral possibilities.

As previously pointed out, almost any conceivable, desirable behavioral effect is reputed to be produced by the intrinsic action of some agent or potion. I hope I have by now convinced you that behavioral intrinsic action in this sense has been a little oversold. But what chemistry fails to effect directly, a social group can create out of mutual conditions of reinforcement occasioned by the stimulus control of the presence of some chemical. In the technical terminology of operant conditioning, then, a drug-taking situation, as well as the bodily presence of a drug, can function as discriminative stimuli for social reinforcement. If a major component of the reinforcing effect of drugs is social, of what does this consist? Those activities functioning as reinforcers clearly will vary with the composition of the social group and its raison d'être. But we can see how a few examples might work, realizing that they are by no means exhaustive. How we comport ourselves when under the influence of alcohol or other drugs is largely defined socially. The entire drug-taking milieu, including how one obtains the drug, as well as behavior "under the influence" defines drug-sanctioned activities. Engaging in these activities is reinforced in varied ways.

With regard to drunkenness, MacAndrew and Edgerton [32] point out that societies in which intoxication gives rise to various social transgressions are societies which indulge the transgressors, so that their bad behavior usually leads to no serious social consequences for them. Drunkeness functions as a "time out" from at least some of the rules of society. Punishment even for homicide is often mitigated if it is done after chemical indulgence. In fact, if you want to get away with it, this is the best time to do nasty things to people. There are seasonal festival and a variety of ritual occasions during which many societies suspend certain taboos and social regulations, granting a shocking license to behavior without any pharmacological assist [15,18]. Lacking much in the way of institutionalized license-granting occasions, we make do with alcohol and other drug pretexts for deviance or rule-breaking behavior.

Drug-associated behavioral license allows the occurence of kinds of behavior that much of the time are problematic

for society-at-large. Individuals find such behavior reinforcing on occasions more numerous than society could normally allow. Thus, being "under the influence" grants us aggressive and sexual indulgences. For the Bolivian Camba it does not do this. They are a people, as described by Heath [32], "virtually lacking in forms of communal expression . . . Geographically dispersed nuclear families are virtually independent of each other, and kinship ties are tenuous and unstable . . . Drinking parties predominate among rare social activities, and alcohol serves to facilitate rapport between individuals who are normally isolated and introverted." For the Camba, then, binging is not so much a "time-out" from social strictures as it is a "time-in" discriminative stimulus for enhancing their lives through social interaction. For many groups, the social context of drug taking is to enhance some aspect of their lives, such as the appreciation of music, attaining an ecstatic religious state, communicating with and being possessed by powerful spirits, or effecting Shamanic cures [7, 16, 21, 49].

Thus far, drug taking has been presented as a discriminative stimulus situation occasioning essentially social reinforcers. But is drug dependence just the operation of stimulus control for the mutual provision of social reinforcers? It is certainly the case that drug dependence is sustained by much more than the drug itself, which even in the case of heroin is often quite dilute by the time it reaches the consumer. There is a network of social reinforcement when individuals continue to bring off the monetary hustles and stable connections necessary for maintaining one's reputation as a "righteous dope fiend" [45]. It is a socially elite attainment and only changes into a retreatist role when an individual no longer can maintain the hustling necessary to attain drugs and becomes identified as an ineffectual "sick addict". This picture, along with material already presented, reveals the importance of non-pharmacological factors, but drugs do indeed have some specific actions. While they do not directly produce behavioral activities, the intrinsic actions of some drugs have behavioral possibilities. The manner in which intrinsic action becomes linked to behavior can illuminate the circumstances under which the linkage becomes chronic. I will try to characterize those intrinsic actions that are necessary, if not sufficient, for capturing the stream of behavior.

First, psychotropic drugs are specific stimuli. Experienced users when injected readily and reliably discriminate one drug from another, even distinguishing from among drugs of the same class [20]. Animals also can learn to make fine drug distinctions when drug injection is used to inform the animal about where to go or what to do in order to obtain a reinforcer such as food [40]. In other words, an administered drug can serve as a distinct informative stimulus with respect to the availability of some reinforcing event. The recent explosion of research in this area has told us much about how rats, pigeons and monkeys, as well as humans, categorize drugs as stimuli and is illuminating the nature of drug receptor systems every bit as quickly and informatively as traditional, isolated-tissue preparations [51]. This discriminative stimulus specificity, then, can be linked readily to reinforcing states of affairs in the environment.

Second, some psychotropic drugs, as well as being able to function as discriminative stimuli, also can function as reinforcing stimuli [25]. The conditions under which this latter function can become chronic and excessive in humans is what the problem of drug dependence is all about. What have animals revealed to us about this? For one thing, animal research and the human record agree as to which types of drugs function as reinforcers. The concordance is not complete, but it is very close [25]. It is close enough so that animal experiments can predict which new drugs have abuse liability. The reinforcing efficacy of a drug, then, is not arbitrary. The research with animals shows how special laboratory arrangements make evident the behavioral potential of drugs as reinforcers. Typically, monkeys are fitted with intravenous catheters and allowed to self-inject drug doses by pressing on a light-weight lever. Hence, drugs are attained by a simple behavior sequence and reach the animal intravenously, a route ensuring a rapid onset of action as it is uncomplicated by delays in absorption or a reluctance to overcome negative tastes. Usually there is little in the experimental situation to compete with drug self-injection, no preexisting behavior routines strongly reinforced by agents other than drugs. These experiments show how strong some drugs can be in preempting the stream of behavior under conditions where other reinforcers are not engaging behavior. What social groups build drug use upon clearly is not arbitrary pharmacologically. But neither is it simply derivable from pharmacological properties.

For a drug with addiction liability to be reinforcing to the point of abuse for humans requires more than simply continued exposure to and availability of the agent. Unlike the monkey, many are exposed but comparatively few abuse. In society, our ecological situation is different than that of the laboratory-dwelling monkey. Most societies provide varied sources of reinforcement to their members who also are restrained from spending too much of their time and resources on drugs. We make abuse easy for our experimental subjects, thus maximizing the efficacy of the intrinsic properties of a drug to engage behavior, i.e., to function as a durable reinforcer. Johanson and Uhlenhuth [26] showed that for normal human volunteers the strong preference for d-amphetamine over placebo disappeared with three successive replications of the experimental series. This is an interesting experiment in several respects. Using a mood scale evaluation of how subjects felt, the drug increased vigor, elation, friendliness, arousal, and positive mood, even though a rather low dose level (5-mg capsules) was employed. Further, these mood responses to d-amphetamine still occurred even in subjects whose preference had changed from taking the drug to taking placebo. The positive mood effects, which are usually assumed to be the basis of the reinforcing effect of stimulants, were not predictive of the disappearance of the drug's reinforcing efficacy. They were not sufficient for the maintenance of drug taking, probably because during the period of drug action these subjects were continuing their normal, daily activities. The drug state may have been incompatible either with the customary pursuit of these activities or the usual effects of engaging in these activities. The point is that in their natural habitat these subjects showed by their preference changes that they were uninterested in continuing to savor the mood effects. They would undoubtedly be poor bets for developing stimulant abuse in spite of their continuing positive mood responses to the drug.

The environmental context, then, in which a drug occurs can alter its potential for acquiring strength as a reinforcer regardless of its pharmacological action. Reinforcing efficacy is malleable. It is malleable by the drug becoming associated as a discriminative stimulus with various time-out and time-in activities. The social attainments and status accorded a righteous dope fiend by the peer group and those hopeful of

entering it are considerable and not unlike many professional aggregations. The dynamics of stimulus-function malleability are just beginning to be mapped. For example, the same peripherally-applied, electrical shock stimulus can function either as a positive or negative reinforcer for an animal within the same experimental session [2]. It depends upon the contingency controlling the delivery of the shock and how the animal historically was introduced to the contingency. Some of the most noxious-seeming events can entrain behavior so that the events are repeatedly self-administered when available under appropriate schedules. Many drugs have noxious aspects, particularly to the drug-taking initiate. These aspects include nausea, panic, frightening hallucinations, and paranoid reactions. But they don't discourage continued commerce with a drug by the serious user. There is no rule that an efficacious reinforcer has to be pleasant in some rosy sense. The course of true reinforcers seldom runs smooth.

Recent experimental work with intraveous drug self-administration in monkeys confirms this picture of contextual malleability. Animals will work assiduously on a variable-interval schedule administering cocaine and simultaenously on a second lever where a fixed-interval schedule leads to one-minute time-out periods from the drug-attaining schedule [44]. A related duality in reinforcing function occurs for nicotine. Intravenously self-administered nicotine was found to have either pronounced reinforcing or punishing effects depending upon the availability contingency. As Goldberg and Spealman [19] state: "These findings are important because they emphasize that the behavioral effects of nicotine are neither immutable nor predictable solely on the basis of the drug's inherent pharmacological qualities."

To summarize: drug stimuli acting as discriminative stimuli can attach to a variety of socially reinforcing functions, from impassioned conversation to sexual and aggressive license. Further, any intrinsic, pharmacological reinforcing functions are altered radically by seemingly small changes in the behavioral context.

Through all this relative flux of determinants, it is still possible to define a few stimulus properties of agents that are necessary, or at least greatly facilitate, the capture of behavior. As indicated in discussing the intravenous route of administration, rapid onset is an advantage in attaining a reinforcing effect. So is brief duration, as it allows a high rate of reinforcing episodes to occur. The preferred drugs of abuse are those possessing rapid onset of action coupled with brief duration of effect; consider belts of liquor, snorts of cocaine, hits of heroin, or drags on smoked substances.

Popular thinking about drug dependence all but equates it with physical dependence, a physiological need state producing a reputed zombie-like uncontrolled drive for the needed drug. The role of physical dependence in drug taking is in most respects a minor one. Drugs such as cocaine can be powerful reinforcers although they do not produce physical dependence. On reviewing the evidence on this general question, Cappell and LeBlanc [3] conclude that "it remains a strong hypothesis if not an act of faith that physical dependence plays a central role in the maintenance of the self-administration of alcohol and psychoactive drugs." In their 1981 review [4] they state: "Physical dependence seems to increase the probability of ethanol self-administration in some circumstances, but this effect is not as reliable as that for opiates. Nothing based in empirical evidence can be said about other drugs where physical dependence is concerned."

I have touched on a few ways in which intrinsic pharmacological action can engage behavior, given the right agents—but equally important—given the right circumstances. Situational circumstances can permit intrinsic action to have free play. Or circumstances can play upon the malleability of intrinsic actions changing them into either reinforcers or negative stimuli. These are ways in which a drug can come to dominante the behavioral domain.

There is another kind of environmental arrangement that produces exaggerated behavior, including overindulgence in drugs. When it comes to the oral route for taking drugs, some humans readily indulge in alcohol and a host of other agents. But the animal experimental literature was, for a long time, quite disappointing in this regard. Animals just could not be enticed to overindulge chronically by this route the way they do intravenously. Perhaps it is due to the noxious taste of most drugs, or to the slow onset of drug action by the oral route. But then again most people do not overindulge either; it takes the right environmental conditions. For animals, the conditions for producing an explosive increase in oral or intravenous drug intake turn out to be not very complex. A relatively small constraint in body weight and an intermittent schedule of access to the relevant reinforcing commodity, i.e., food, is sufficient. For example, although never deprived of water, rats receiving small food pellets on the average once per minute drank ten times as much water in three hours as they did when receiving the same number of pellets all at once and observed for three hours [8,9]. They drank about half their body weight in three hours when on the intermittent food schedule. Hence, this phenomenon has been called "schedule-induced polydipsia". This overindulgence goes on for months during each daily intermittent feeding session. It has no explanation in terms of standard physiological, nutritional or behavioral considerations [10]. Schedule-induction conditions produce many other kinds of behavioral excesses: attack, pica, hyperactivity, escape and drug intake [11,12]. They occur in a wide range of species. Under similar schedule conditions, humans show hyperactivity, overdrinking of water and increased smoking [12]. In general terms, it is not just deprivation, but temporal constraints on the episodic delivery of a valued commodity in one domain that induces excessive behavior in another domain. Of importance in the present context is the schedule-induced production and maintenance of drug overindulgence. This has been demonstrated for a number of drugs taken orally [6, 17, 33, 47]: alcohol, barbiturates, opiates, phencyclidine and amphetamine, as well as intravenously: heroin, methadone, cannabis and nicotine [35, 42, 46]. For example, alcohol was drunk excessively by a group of rats exposed continuously to an intermittent feeding schedule [13]. The alcohol solution was preferred to water and some other solutions and the chronically excessive intake resulted in severe physical dependence. Some of these agents, particularly when taken orally under normal circumstances, function only as weak reinforcers for animals. Schedule-induction conditions greatly increase the reinforcing efficacy of these drugs and they are taken to excess. Schedule-induced drug overindulgence remains strictly a function of the current induction conditions. Even with a long history of schedule-induced alcohol drinking, with the development of physical dependence, termination of the scheduled aspect of feeding produces an immediate fall in alcohol intake to a control level [48]. Once again we have a picture of a reputedly enticing molecule failing to take over behavior in spite of chronic binging. We should not be surprised since altered

circumstances revealed that heroin also had not taken over the Vietnam servicemen's behavior in a chemical-enslavement sense.

The texture of the reinforcement environments provided by both nature and society can be described as containing a host of intermittent schedules with properties sufficient for the induction of excessive behavior. These can be designated as "generator schedules". Life could be described as a scramble for commodities and activities, which are only intermittently attained: food, territory, money, sexual and social intercourse. The particular excessive behavior induced by these natural generator schedules depends upon what behavioral opportunities are available in life's situations, and whether the individual is prepared to exploit these opportunities. Drugs offer a quick and powerful behavioral alternative when they occur in an impoverished environment upon which common generator schedules are imposed. By an impoverished environment I mean one which is poor economically or educationally or in terms of a socially reinforcing matrix. With less impoverishment, there is a greater probability that socially acceptable excessive behavior will occur in the face of generator schedules. The individual then has the personal resources to get intense about business, scientific, artistic, or harmless hobby endeavors. In terms of drug dependence alleviation, we cannot alter genetic or personal histories. Nor has prohibition of drug supplies led to signal successes. Alleviation and prevention can be approached most effectively through environmental changes: both by alteration of generator schedules and enrichment of environmental alternatives.

Perhaps it is time to make explicit reference to the title of this presentation. In what senses might drug dependence be either a myth or a motive? The development of physical dependence upon some drugs is certainly no myth, nor are the medical consequences of chronic overuse of certain agents. But as an explanation, a mechanism of action, accounting for deviant and delinquent activities, physical dependence is inadequate. Neither is the evolution of one's major interests into seeking and taking drugs merely a problem of avocation or aesthetics. It can be a symptom of a serious diversion or arrest in life's trajectory. Drug dependence is not a motive in the sense that a drug is an irresistible goody, or that its habitual use leads to a physical dependence driving further drug seeking. Pharmacologic structure does not imply motivational destiny. Yet the suppositions surrounding the notion of "drug dependence" often give a mythic, rather than a scientific, account of the implied behavioral troubles. It is an irksome problem because the line between science and myth is not always clear. As Jacob ([23], p. 11) states, "myths and scientific theories operate on the same principle. The object is always to explain visible events by invisible forces, to connect what is seen with what is assumed." But while "Scientific investigation begins by inventing a possible world, or a small piece of a possible world . . . a myth . . . is not just a tale from which inferences can be drawn about the world. A myth has moral content" ([23], p. 12). I'm afraid that many of our scientific notions about drug dependence are burdened with a heavy load of mythic, moral freight.

As each underclass begins to emerge in our society, as they become visible, they have attributed to them certain frightening characteristics. They are alledged to be aggressive, over-sexed and shamefully poor. This is typically the case for emerging foreign minorities, blacks, women, teenagers, and lately the aged or infirm. Each of these groups also gets some sort of substance dependence attributed to them as the mechanism of action which accounts for their ill-temper, hypersexuality, and poverty. Chinese and opium, Indians and alcohol, blacks and heroin or cocaine, teens and drugs, alcoholism in women, the homeless, and the aged. It's not that people don't have drug problems. What I question is that drugs are the major factor underlying their problems. And the problems that *are* attributed to these emerging groups are mostly not really their problems. These groups often function as wonderous screens on which to project our forbidden aggressive and sexual fantasies. They get to indulge themselves in these not-so-innocent social and chemical freedoms. It serves them right if they're underpaid. Anyhow, they got into these troubles because they abuse alcohol or some other drugs. It's comforting to fasten on this morality play and rightously combat "the problem of drug dependence".

We need to remind ourselves that drugs do not have the powers to do these things. There are reinforcers that are sweeter than drugs. It's a pity that most of them don't have the simplicity or permanence of molecular structure. The thing about drug dependence is the certainty of the effect of the drug in the context in which it's taken. It's dependable. All the more's the irony that most of this effect is situationally fabricated or socially constructed. But neither the transitory, nor certainly the illusory, has yet interfered with reinforcement efficacy in this world.

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