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Cigarette Smoking and the Addiction Controversy: Why Do Opinions Differ?

Introduction

For the purpose of this report, drug addiction, drug dependence and drug abuse will be taken to mean the same thing and will be used interchangeably. Regardless of its name, addiction is a hypothetical construct. It is not an entity, such as a bird or an apple which have defining characteristics upon which people can agree. Addiction must be inferred from behavior. This fact has some interesting ramifications. For example, since addiction has no independent reality, reasoned and reasonable people can view the term from different perspectives. A psychologist can take addiction to mean a cluster of symptoms and behaviors he has observed in his patient population. A pharmacologist may say addiction consists of certain physiological signs that occur when a person takes or ceases taking a drug.

The definition of hypothetical constructs can change over time, depending on the zeitgeist, for example. This has certainly happened with addiction. In the past, it was held that addictive drugs produced intoxication. It is currently believed, among some, that intoxication is not a necessary criterion in defining addiction (1). In the future, it is certainly possible that the definition of addiction will change again.

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Different cultures may view hypothetical constructs differently. English-speaking people tend to say that addiction and dependence are the same thing. To a German, "die Sucht" (addiction) and "die Abhängigkeit" (dependence) are quite different (expand).

To the degree that the language we speak shapes how we think about things, people who speak different languages will have different views about hypothetical constructs. An American and a German can agree on what an apple is. But addiction can mean something very different to an American and a German. The English word "addiction" is derived from the Latin word "addicere" which means to sentence, as to prison. This connotes that a person is imprisoned by his habit. The German word "die Sucht" derives from the old German word "suht" which means illness (2). This connotes that the drug user is an unfortunate victim, not a criminal. (Expand: Anglo-Saxon world, also expand to "suchen").

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change in German etymology is paralelled by change in definition of addiction: from intoxication to more behavioral

Cigarette Smoking an Addiction?

Keeping in mind that addiction is a hypothetical construct, one may ask whether cigarette smoking is an addiction? Naturally, it depends on which way you choose to define addiction. In 1988, a Surgeon General's report (3) was issued entitled: "The Health Consequences of Smoking: Nicotine Addiction". (It is interesting that a less negatively charged word such as dependence was not used in the title). In the report, 3 primary criteria for drug dependence (not addiction) were used. These criteria were: highly controlled or compulsive use, psychoactive effects and drug-reinforced behavior. Additional criteria included: stereotyped pattern of use, use despite harmful effects, relapse following abstinence, recurrent drug cravings, tolerance, physical dependence, pleasant (euphoric) effects?. According to the

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primary criteria listed above, is cigarette smoking a nicotine addiction? It is imaginable that some people might come to that conclusion.

Let us first examine the criterion of highly controlled or compulsive use. I take this to mean that the individual who is addicted exhibits habitual behaviors with respect to his addiction. It is useful to examine how habits are acquired. Behaviors that are rewarded (reinforced) tend to occur more often. A hungry rat who accidentally presses a lever and is given a pellet of food will, over time, acquire the habit of lever pressing. In this case, the reward is obvious - food. In humans, the acquisition of habits by rewarding behaviors is often less obvious. What is the reward in knuckle cracking or finger nail biting? Yet the reward must exist or else these habits would not be acquired. Perhaps the reward is tension reduction ... but the reward must certainly occur.

It is clear that in this context smoking is a habit. The response that is rewarded is the puff of a lit cigarette. The reward is nicotine. A person who smokes a pack of cigarettes a day is rewarded over 58,000 times a year. Since the strength of a habit depends, to a large extent, on the number of times it has been reinforced, the smoking habit can be very strong indeed!

Humans, being complex animals, acquire all kinds of habits. I think that the "Twinkie" defense is cogent here. A person who has a Twinkie every afternoon probably has acquired the Twinkie habit.

When habitual behaviors are prevented from occurring, the organism becomes frustrated, or anxious and seeks to reduce the frustration by performing that behavior. The inveterate

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Twinkie eater who has run out of Twinkies will dart to the store to buy some more Twinkies. When a cigarette smoker is prevented from performing his well-learned habit he becomes frustrated and seeks out the opportunity to smoke. Contrast this situation with the heroine user who has run out of heroine. He experiences profound and incapacitating withdrawal symptoms (4). Frustration does not equal withdrawal. Nicotine is the primary reward or reinforcer in cigarette smoke. However, it is in the nature of habits, that cues or signs associated with habits can also serve as reinforcers and come to be pleasurable in their own right. These cues are known as secondary reinforcers. The obvious secondary reinforcers in cigarette smoke are sensory ones: taste, smell, feel, and so forth. Less obvious, but not less important, secondary reinforcers are associated with smoking. Smoking is done when the individual is in some physical and psychological state and these states become associated with the act of smoking.

For example, a person who is anxious discovers that smoking helps him relax. Therefore, anxiety serves as a cue to smoke.

Environmental cues can also serve as secondary reinforcers for smoking. If a person smokes in his office the cues associated with the office ... the desk, the phone, the books ... become associated with the act of smoking and serve as cues to smoke. Similarly environmental cues can be associated with cues not to smoke. A "no smoking" sign is a good example of such a cue.

The interesting thing about secondary reinforcers is that they serve to energize habits. The desk elicits the desire to smoke while the "no smoking" sign elicits the desire not to smoke.

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It has been argued that nicotine is as addictive as heroine (5). Part of this claim is based on the observation that relapse rates following cessation are similar (6). Just because relapse rates are similar for smoking and heroine use does not mean that the mechanisms are the same. A heroine user takes the drug only one or two times a day. A pack a day smoker is reinforced around 150 times per day. This point is important because the strength of a habit is related to how often it is reinforced. The smoking habit is difficult to give up because it has been reinforced so often, not because smoking is addicting.

How does one explain the observation that some former smokers, long after ~~to~~ adjusting to life without cigarettes, resume the smoking habit? This may be explained by the fact that habits are permanent (7). The former smoker is, in reality, a current smoker: one who has cut his consumption to zero (8). He is a smoker who has extinguished the smoking response. An extinguished response can spontaneously recover. As every psychology student who ever trained a rat to press a lever for food knows, if you stop rewarding the rat with food, it will eventually stop pressing the lever. The longer the rat has been trained the longer it will take for the lever pressing response to be extinguished. The curious student may, after a few months, take his rat back to the lab to see what happens. The rat starts pressing the lever again! This is the phenomenon of spontaneous recovery. The strength of spontaneous recovery also depends on how long the animal had been trained initially. Admittedly most humans are not rats, but the principles of learning and reinforcement apply to both organisms equally well. Spontaneous recovery of a well-learned habit may explain why former smokers resume the habit months or years after quitting.

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The second primary criterion for drug dependence in the 1988 Surgeon General's report is psychoactive effects. The Twinkie defense can profitably be reactivated in this context. Twinkies are, in fact, psychoactive ~~(9)~~. Eating a Twinkie activates sugar receptors in the brain (9). (Incidentally, one <u>can</u> die from eating a Twinkie if one has a condition known as glucose intolerance (10).)

In general, any substance that exerts an effect on the brain is psychoactive. Caffeine is psychoactive (11). It activates brain structures associated with alertness and arousal (12). It should be noted that cola makers "spike" their beverages with additional caffeine (13), although they claim to do it for reasons of flavor. Alcohol is certainly psychoactive (14). I am sure that Bourbon producers try to control the level of alcohol in their products. Fortified wine makers even "spike" their products with additional alcohol. As can be seen, the criterion of psychoactivity is not a defining characteristic of drug dependence. A defining characteristic should be the effects produced by the psychoactivity. If the effects alter consciousness, impair performance and prevent a person functioning in normal society, then the drug is a problem. If the drug does not do these things, then the fact that it is psychoactive, means absolutely nothing. Nicotine, as delivered in cigarette smoke does not alter consciousness, impair performance or prevent a person from functioning in normal society. Therefore, the fact that nicotine is psychoactive is of little consequence.

The third primary criterion in the 1988 Surgeon General's report is drug reinforced behavior. In the somewhat circular logic of psychologists, a reinforcer is anything that increases the probability of the response that precedes it. To return to the rat, the food pellet that is preceded by the lever press is a reinforcer. To put it another way, a reinforcer is anything an organism will work

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to obtain. Put more simply, a reinforcer is anything the organism likes. Reinforcers include such things as food, water, sex, drugs, money, sucrose, and so forth. Twinkies are certainly reinforcering (Twinkies have now fulfilled the three primary criteria for a dependence producing substance).

Is nicotine, as delivered cigarette smoke, reinforcing? Of this, there can be little doubt. Smokers like cigarettes with nicotine and dislike cigarettes with minimal or no nicotine. Although nicotine is a necessary condition, it is not a sufficient condition to maintain smoking. As stated earlier, secondary reinforcers such as taste and smell are as important as nicotine.

To find out, whether for a given organism, a substance is reinforcing, researchers determine whether the organism will work for it. A rat will work for a sugar solution while a cat will not. Therefore, sugar is a reinforcer for the rat, but not the cat. Not all substances are reinforcing for all organisms.

To determine which of two substances is more reinforcing, one compares how hard the organism will work for them. Rats will work very hard for sugar water, less hard for plain water. Another important factor to consider is: at what dose is a substance a reinforcer for an organism? Rats will work very hard for low concentrations of a saccharine solution but will not work at all for high concentrations.

Finally, route of administration must be reconsidered. Sugar solution delivered orally is more of a reinforcer than the same solution given intravenously (IV). Experimental studies on the reinforcing properties of nicotine have usually employed IV nicotine administration. The

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majority of the more recent studies have been on rats, although dogs, monkeys, humans and other species have also been used (15).

In general, it has been found that organisms will work for IV nicotine (16). Organisms will also work for IV cocaine (17). Does this mean that nicotine is just like cocaine? No, it simply means that organisms will work for both nicotine and cocaine. A lever press is just a lever press. It tells you nothing about what is going on inside. Will the organism work just as hard for nicotine as for cocaine? Under normal conditions, absolutely not (18). Under extraordinary conditions, organisms can be trained to work hard for nicotine (19). But under extraordinary conditions, wily psychologists have trained animals to shock themselves with electricity at high rates (20)! So the fact that animals will work hard for nicotine in special circumstances, in and of itself, tells us nothing.

Nicotine is a reinforcer. Its' reinforcing properties are mediated by the organ of behavior, the brain. When nicotine's actions on the brain are blocked, it ceases to be a reinforcer (21). Given these facts, one may ask what parts of the brain are responsible for nicotine's reinforcing properties? It is currently held by many, that all rewarding drugs affect the same parts of the brain, namely, the dopamine reward system (22). A number of studies have demonstrated that various drugs of abuse (e.g., cocaine and heroine) affect the dopamine reward system (22). Recent studies also suggest that nicotine influences this system (23). This has been taken as further evidence that nicotine is like drugs of abuse. What is often neglected in this argument is that caffeine, food, and water also affect the dopamine system (22). Clearly, what we are looking at is a system that is involved in reinforcement itself, whether the reinforcement is through drugs of abuse, caffeine, nicotine, or the natural reinforcers of food and water.

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It would be useful to discuss some of the additional criteria for dependence used in the 1988 Surgeon General's report and determine how these criteria relate to cigarette smoking and nicotine. The first of these additional criteria is stereotypic pattern of use. I take this to mean that the behavior becomes ritualized, in that the method or procedure of performing the act follows a similar topography on each occasion. Stereotypy is characteristic of well-learned habits. Habits such as these become automatized through repetition and may even be rendered unconscious (24). Stereotypy is not a characteristic of addiction. It is a characteristic of habits, whether it is lever pressing, car driving, or cigarette smoking.

Another additional criterion in the 1988 report is use despite harmful effects. With respect to cigarette smoking, this can be read as "possible harmful effects". Cigarette smoking may be a risk factor for possible harmful effects in the future. Whether the smoker develops an alleged smoking-related illness is probabilistic and the smoker is betting that he won't become ill. The situation with cocaine and heroine is quite different. With these drugs and others, the harmful effects, both to the individual and society are immediate. The individual must take close to toxic doses of heroine, for example, in order to get the desired effects. In fact, the desired effects from heroine are actually symptoms of toxicity. Societal harm is difficult to measure. That the user is impaired in functioning normally, however, speaks to the reality of this societal harm.

The additional criteria of relapse following abstinence and recurrent drug cravings were dealt with earlier in the discussion on smoking as a habit. That is, relapse was explained in terms of spontaneous recovery and craving was explained in terms of secondary reinforcers and the cues to smoke that these reinforcers produce. The additional criterion of tolerance will be dealt

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with extensively by others but a few words are appropriate in this context. Tolerance can mean two different things (4). First it can mean that symptoms occurring after taking a drug for the first few times no longer occur. For example, a person who wears a scopolamine patch for sea sickness may initially feel sleepy. With continued use, however, this symptom may lessen or disappear. If this occurs, the person is said to have become tolerant to the sleepiness-producing effects of the scopolamine patch. Second, tolerance can mean that a person must take even increasing amounts of a drug in order to produce the desired effects. Chronic heroine users, for example, must continually increase their dose in order for them to feel the way they did when they first started taking the drug.

Does nicotine, as delivered in cigarette smoke, produce tolerance? Nicotine clearly produces the first kind of tolerance and clearly does not produce the second kind of tolerance. Novice smokers frequently report dizziness, cough and sometimes nausea the first few times that they inhale cigarette smoke. These symptoms quickly disappear as the person becomes accustomed to smoking and learns to regulate his intake. Must a person continually increase the number of cigarettes he smokes in order to obtain satisfaction? No, as the smoking habit matures, the person reaches a plateau in the number of cigarettes he smokes per day and remains at that level for years. In fact, there are some indications that smoking more than the accustomed amount in a given day may actually be aversive.

Physical dependence is another additional criterion in the 1988 Surgeon General's report. According to Warburton (25) physical dependence is inferred from the abstinence syndrome that occurs when a person stops using a drug. With respect to smoking cessation, the following symptoms have been reported to occur: craving for tobacco, irritability, impatience,

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frustration or anger, anxiety, difficulty concentrating, restlessness, decreased heart rate, increased appetite, weight gain, depression, disturbed sleep, difficulty in socializing, constipation, decreased levels of adrenaline and noradrenaline in urine, altered electroencephalographic patterns while awake and asleep and decrements in performance on some cognitive tasks (26). It should be noted that not all of the symptoms are said to occur in every individual. In fact, 25 percent of smokers have no symptoms upon quitting (27). In any case, most of the symptoms listed above can result from the interruption of a well-learned habit. Lets return to the rat example. The rat has been trained to press a lever for food reward. After the lever pressing response has been well established, you now stop rewarding the rat. What happens? The rat exhibits behavioral and physiological signs of withdrawal. Behaviorally it presses the bar faster and may even gnaw on it, which may be interpreted as craving, impatience, frustration, etc. Physiological signs of withdrawal include changes in heart rate, blood pressure and hormone levels (ref.). Thus, it is clear that behavioral and physiological signs following smoking cessation does not necessarily equate with a physical dependence explanation. The signs can also be explained in terms of the interruption of a well-learned habit. The last of the additional criteria in the 1988 Surgeon General's report is pleasant (euphoric) effects. The dictionary defines euphoria as "a feeling of great happiness or well-being". I have never known a smoker who says that smoking gives him a feeling of great happiness or well-being. Yet, there are those activists in the scientific community who would like to equate the euphoriant-producing effects of drugs such as cocaine, with the effects produced by cigarette smoking and nicotine administration (28). This comparison fails on the grounds of common sense. Cocaine users often describe the euphoria as a "sexual thrill" (29). The only link that I can imagine between cigarettes and sexual thrill is the role of smoking as a

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"digestive". Smoking is pleasurable, by definition, since people do it. However, to compare the pleasure derived from smoking to the high (euphoria) produced by cocaine is sheer folly.

The primary and secondary criteria for drug dependence in the 1988 Surgeon General's report on smoking can be applied to habits of all types without streching rules or embellishing definitions. According to the criteria, coffee drinking, cola drinking, Twinkie eating and cigarette smoking are drug addictions, just like heroine and cocaine use. When the behaviors inferred from the hypothetical construction of addiction are so all-encompassing as to include almost all habitual behaviors, the construct ceases to have scientific merit. The Surgeon General's definition of addiction, then, remains only valid as a political tool devoid of scientific value.

References

(1) Jaffe, J.H.:
Drug addiction and drug abuse.
in: Goodman and Gilman's (Eds.): The pharmacological basis of therapeutics,
Pergamon Press, 8th ed., 1990, pp. 522-573

(2) Brockhaus Enzyklopädie, Mannheim: Brockhaus, 1993

(3) USDHHS:
Nicotine addiction: a report of the Surgeon General.
U.S. Department of Health and Human Services,
Office of the Assistant Secretary for Health.
Office on Smoking and Health, Rockville, MD (1988)

(4) Jaffe, J.H.:
Drug addiction and drug abuse.
in: Goodman and Gilman's (Eds.): The pharmacological basis of therapeutics,
Pergamon Press, 8th ed., 1990, pp. 522-573

(5) Henningfield, J.E., Cohen, C., Slade, J.D.,
Is nicotine more addictive than cocaine?
Br. J. Addict. 86: 565-570 (1991)

(6) Benowitz, H.L.,
Cigarette smoking and nicotine addiction,
Medical Clinics of North America, Vol. 76: 415-437 (1992)

(7) Logan, F.A.:
The smoking habit.
in: Hunt, W.A. (Ed.): Learning mechanisms in smoking,
Chicago: Aldine Publishing Company, 1970, pp. 131-145

(8) Logan, F.A.:
The smoking habit.
in: Hunt, W.A. (Ed.): Learning mechanisms in smoking,
Chicago: Aldine Publishing Company, 1970, pp. 131-145

(9) Schmidt, R.F.: Thirst and hunger. General sensations.
in: Schmidt, R.F., Theus, G. (Eds.): Human physiology,
Berlin: Springer Verlag, 1983, p. 312

(10) Deems, D.A., Doty, R.L., Settle, R.G. Shaman, P., Mester, A., Moore-Gillon, V.,
Kimmelman C.P., Brightman, V.J., Snow, J.B.,
Smell and taste disorders: an analysis of 750 patients from the University of
Pennsylvania Smell and Taste Center, 1990,
Archives of Otolaryng. and Head and Neck Surg. 117: 519-528 (1991)

(11) Benowitz, N.L.:
Clinical pharmacology of inhaled drugs of abuse: Implications in understanding nicotine dependence.
in: Chiang, C.N., Hawks, R.L. (Eds.): Research findings on smoking of abused substances,
Washington DC: Supt. of Documents, NIDA Research Monograph 99, 1990, p. 12

(12) Benowitz, N.L.:
Clinical pharmacology of inhaled drugs of abuse: Implications in understanding nicotine dependence.
in: Chiang, C.N., Hawks, R.L. (Eds.): Research findings on smoking of abused substances,
Washington DC: Supt. of Documents, NIDA Research Monograph 99, 1990, p. 12

(13) Benowitz, N.L.,
Clinical pharmacology of caffeine,
Annu. Rev. Med. 41: 277 (1990)

(14) Jaffe, J.H.:
Drug addiction and drug abuse.
in: Goodman and Gilman's (Eds.): The pharmacological basis of therapeutics,
Pergamon Press, 8th ed., 1990, pp. 522-573

(15) Stolerman, J.P.:
in: Wonnacott, S., Russell, M.A.H., Stolerman, J.P. (Eds.):
Nicotine psychopharmacology: Molecular, cellular, and behavioural aspects,
Oxford: University Press, 1990, pp. 96-111

(16) Swedberg, M.D.B., Henningfield, J.E., Goldberg, S.R.:
in: Wonnacott, S., Russell, M.A.H., Stolerman, J.P. (Eds.):
Nicotine psychopharmacology: Molecular, cellular, and behavioural aspects,
Oxford: University Press, 1990, pp. 38-76

(17) Goldberg, S.R., Henningfield, J.E.,
Reinforcing effects of nicotine in humans and experimental animals responding under intermittent schedules for i.v. drug injection,
Pharmacol. Biochem. Behav. 30: 227-234 (1988)

(18) Risner, M.E., Goldberg S.R.,
A comparison of nicotine and cocaine self-administration in the dog: fixed-ratio and progressive-ratio schedules of intravenous drug infusion,
J. Pharm. Exp. Ther. 224: 319-326 (1983)

(19) Mc Kearney, J.W.,
Maintenance of responding under a fixed-interval schedule of electric shock presentation,
Science 160: 249-251 (1968)

(20) Mc Kearney, J.W.,
Maintenance of responding under a fixed-interval schedule of electric shock presentation,
Science 160: 249-251 (1968)

(21) Corrigal, W.A., Coen, K.M.,
Psychopharmacology 99: 473-478 (1989)

(22) Wise, R.A., Rompre, P.P.,
Brain dopamine and reward,
Annu. Rev. Psychol. 40: 191-225 (1989)

(23) Reavill, C.:
Actions of nicotine on dopamine pathways and implications for Parkinson's disease.
in: Wonnacott, S., Russell, M.A.H., Stolerman, J.P. (Eds.):
Nicotine psychopharmacology: Molecular, cellular, and behavioural aspects,
Oxford: University Press, 1990, pp. 307-340

(24) Kihlstrom, J.F.,
The cognitive unconscious,
Science, Vol. 237: 1445-1452 (1987)

(25) Warburton, D.M.,
Is nicotine use an addiction?
Psychologist 4: 166-170 (1989)

(26) Jaffe, J.H.:
Tobacco smoking and nicotine dependence.
in: Wonnacott, S., Russell, M.A.H., Stolerman, J.P. (Eds.):
Nicotine psychopharmacology: Molecular, cellular, and behavioural aspects,
Oxford: University Press, 1990, pp. 1-37

(27) Shiffman, S.M.:
The tobacco withdrawal syndrome.
in: Kransnegor, N.E. (Ed.): Cigarette smoking as a dependence process,
Washington DC: National Institute for Drug Abuse, 1979

(28) Henningfield, J.E.:
Behavioral pharmacology of cigarette smoking.
in: Thompson, T., Dews, P. B., Barrett, J.E. (Eds.):
Advances in Behavioral Pharmacology Vol. 4,
New York, Academic Press, 1984, pp. 131-210

(29) Warburton, D.M.:
The functional use of nicotine.
in: Wald, N.J., Froggatt, P. (Eds.):
Nicotine, smoking and the low tar programme,
Oxford, London, 1988, pp. 182-199