

## RESEARCH REPORT

# Concepts of drugs: differences in conceptual structure across groups with different levels of drug experience

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### Abstract

*Seventy-seven college students varying in degree of drug use experience rated the perceived similarities of all possible combinations of 16 drug classes (cigarettes, other tobacco, alcohol, marijuana, barbiturates, minor and major tranquilizers, amphetamines, amphetamine derivatives, cocaine, heroin, opiates, hallucinogens, inhalants, PCP, anti-depressants). Multi-dimensional scaling (INDSCAL) and network models (PFNET) indicated that abstainers had only one pharmacological category involving sedatives/depressants, and that they attached more importance to whether drugs were licit vs. illicit than to whether they were depressants vs. stimulants. Conceptions became more coherent, differentiated and based on pharmacological properties for more experienced drug users. In line with previous work, groups with greater experience with drugs had more sophisticated conceptions not only about the drugs they had used, but also about drugs they had not used. These findings suggest that early on in drug behavior sophisticated and interrelated concepts are developing that should be taken into account when designing interventions and information campaigns.*

### Introduction

Adolescents and young adults in the United States who become drug users go through a series of cumulative stages in progressing from no drug use to initial, legal drug use to "harder", illegal drug use (Kandel & Faust, 1975; Donovan & Jessor, 1983; Fisher *et al.*, 1987; Voss & Clayton, 1987; Andrews *et al.*, 1991). Later drug use stages are characterized by the use of all drugs prior to that stage (e.g. nearly all marijuana users also use alcohol and most use cigarettes), as well as a higher probability of drug use problems. Research (e.g. Schlegel &

DiTecco, 1982; Roizen, 1983; Goldman, Brown & Christiansen, 1987; Leigh, 1987; Mann, Chassin & Sher, 1987; Oei & Burton, 1990) has shown that greater use of a drug is associated with less concern about harmful consequences of that drug, and more positive and differentiated expectations about the use of that drug.

In a previous paper (Fabricius, Nagoshi & MacKinnon, 1993), we reported that similar relations between use and beliefs exist *across* drugs. Specifically, there was evidence for two types of halo effects. Subjects had lowered concern about harm, and more differentiated expectations

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about harm, not only for the drug or drugs that they were using but also for drugs characteristic of later drug use stages. These results suggested that changes in cognition may predispose individuals to progress from one stage of drug use to the next. The purpose of the present paper was to determine whether such "across the board" beliefs extended to knowledge about the pharmacological properties of a wider range of drugs.

In our previous study, a large sample of college students rated a series of descriptions about a hypothetical drug user on the degree that drug use was "harming" that individual. These descriptions varied all combinations of the type of drug (cigarettes, alcohol, marijuana, cocaine), social status of the person (accountant, custodial worker), frequency of use (weekly, daily) and location of use (never at work, sometimes at work). Differentiated beliefs were operationalized as those that took into account social status, frequency, and/or location in judging how harmful drug use would be. Subjects were classified into drug use stage (abstainers, low alcohol users, high alcohol users, cigarette users, marijuana users, cocaine users) based on the logic of the studies cited above. Abstainers reported no use of any of the four drugs. Alcohol users reported no use of any of the other three drugs. Cigarette users reported no use of marijuana or cocaine, and almost all of them used alcohol. Marijuana users reported no use of cocaine, and almost all of them used alcohol and half used cigarettes. Almost all the cocaine users used alcohol, half used cigarettes, and most used marijuana.

Abstainers had some differentiated beliefs about alcohol. Lower levels of alcohol use were associated with differentiated beliefs about cigarettes and marijuana, and increased use of alcohol was additionally associated with lowered concerns about the harmfulness of cigarettes and marijuana, and also with some differentiation and lowered concerns about cocaine. Use of marijuana was accompanied by highly differentiated beliefs about cocaine. Finally, there were no beliefs about other drugs that could be directly traced to cigarette use. Ratings of cigarette users appeared to be driven by the proportion of low and high alcohol users among them.

The Fabricius *et al.* (1993) study was limited to examining beliefs about the harmfulness of four drugs. In the present study we were interested in more specific aspects of subjects' knowl-

**Table 1.** Drug classes and examples of each used in the present study

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Cigarettes: menthols, filters
Other tobacco products: cigars, snuff, chewing tobacco
Alcohol: beer, wine, fortified wine, distilled spirits
Marijuana: THC, hashish, hash oil, pot
Heroin: horse, H, chasing the dragon
Opiates: morphine, methadone, opium, codeine
Cocaine: snow, crystal, crack, freebase
Major tranquilizers: thorazine, mellaril, clozapine
Minor tranquilizers: benzodiazepine, valium, librium, milltown
Amphetamines: speed, crank, uppers, crystal meth (ice), preludein
Amphetamine derivatives: MDMA, ecstasy, designer drugs
Barbiturates: downers, reds, yellows, quaaludes, doriden
Hallucinogens: acid, LSD, mescaline, peyote, mushrooms
PCP: flakes, lovely, angel dust
Inhalants: glue, thinner, spray paint, amyl butyrates, poppers
Antidepressants: elavil, tofranil, norpramin, nardil, prozac

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edge about a wide range of different drug classes, shown in Table 1. We examined how subjects categorized these drug classes. These drug classes were chosen because they encompass the common psychoactive drugs with possible abuse liability. They represent stimulant, depressant, hallucinogenic, and anxiolytic (hedonic) drug effects. This made it possible to determine which if any pharmacological criteria subjects at different drug use stages used to categorize drug classes, and whether they also used other criteria, such as social norms or drug legality.

College students at different drug use stages rated the similarity of all possible pairs of the drug classes. We employed two data analytic techniques, multi-dimensional scaling (INDSCAL), and Pathfinder network models (PFNET). In multi-dimensional scaling, the rated similarity between stimulus items is represented by the metric distance between the items located in some coordinate space, typically a plane. The dimensions of the space represent the important psychological dimensions that organize subjects' knowledge of the stimulus domain. In the INDSCAL model, we entered each drug user group as one "individual". The INDSCAL model assumes that individuals (in this case, drug user groups) share a common structure of

the stimulus domain but differ in the weightings, or emphasis, they place on particular stimulus dimensions (Carroll & Chang, 1970).

Multi-dimensional scaling techniques have been used to assess differences in the way drug information is processed by individuals at different stages of drug use. Rather, Goldman, Roehrich & Brannick (1992) used these techniques to map the cognitive network through which individuals retrieve information from memory in their decision to use alcohol. Rather *et al.* (1992) found that expectancies of alcohol effects (Goldman *et al.*, 1987; Leigh, 1989) could be placed along two dimensions of (a) social/positive vs. antisocial/negative and (b) arousing vs. sedating. Heavier drinkers were found to expect more arousing effects, while lighter drinkers expected more sedating effects, i.e. these groups differed in the expectancies that were likely to be accessed in the decision to use alcohol. These same two dimensions were confirmed in a subsequent study (Rather & Goldman, 1994) with adults.

Dunn & Goldman (1996) extended the methodology of the Rather *et al.* (1992) study to a sample of second to fifth graders, who generally had no or minimal experience with alcohol, and again found both the evaluative and the arousal-sedating dimensions in the structure of these children's expectancies of alcohol effects. In addition, Dunn & Goldman found that the older children tended to place greater weight on the latter rather the former dimension compared to younger children, as well as expecting more positive outcomes from drinking. These developmental shifts in cognition would appear to prime these children for the onset of alcohol use.

Network models have been used much less frequently to model drug use or drug belief data, yet they can provide an important addition to multi-dimensional scaling, because they can show the groupings of items that form categories in subjects' knowledge. Rather & Goldman (1994) applied complete linkage cluster analysis to alcohol expectancies. They obtained similarity judgements of alcohol expectancies rather than Likert scale-type responses used in Rather *et al.* (1992) and Dunn & Goldman (1996). Results showed that heavier drinkers had a more tightly connected category of social/positive and arousing expectancies than did light drinkers.

Network models represent rated similarity by some measure of the distance between the items

located as nodes in some graph. The PFNET (Dearholt & Schvaneveldt, 1990) model uses the number of links between items along indirect paths through other items, rather than the length of the links, as a representation of the rated similarity of those items. PFNET identifies those individual links that provide the most efficient connections among the items. Thus, PFNET provides a useful method for identifying those items seen as most similar, and as such is complementary to multi-dimensional scaling. While multi-dimensional scaling can give insight into the underlying dimensions that organize subjects' knowledge of a whole set of items, it attempts to minimize a global error criterion by moving individual items and can thus distort precisely those local relationships that PFNET uses to construct a representation of subjects' similarity ratings (Dearholt & Schvaneveldt, 1990). In other words, multi-dimensional scaling attempts to find a suitable representation by using the items that subjects see as most different to anchor the ends of various potential dimensions, while PFNET attempts to build up a representation by linking together each item with the item or items that subjects see as most similar to it.

It was expected that the present results would be concordant with those from the Fabricius *et al.* (1993) study, with abstainers having less differentiated structures, perhaps based more on social criteria such as drug legality, while alcohol, marijuana and cocaine users would have increasingly differentiated structures, perhaps based on pharmacological properties. In particular, we sought to replicate the finding of halo effects—that these differences between groups would extend to as-yet-untried drug classes. Differences in conceptual structure across drug use stages are important to document because they may reflect changes in the information accessed in the decision to use later drugs, as subjects become more experienced with earlier drugs.

## Methods

### Subjects

Forty-nine females and 28 males were recruited from developmental psychology classes at Arizona State University and completed the study for course credit. Mean age was 23.6 years ( $SD = 4.3$ ), and 88% of the sample was

Caucasian. Special efforts were made to oversample abstainers from drug use.

### Procedure

Prior to working on the similarities task, subjects completed a brief questionnaire on their sex, age, ethnicity, and alcohol and drug use. Frequency of alcohol use in the past year was coded 1 = less than once a month, 2 = once a month, 3 = two to three times a month, 4 = once a week, 5 = two to three times a week, 6 = four to five times a week, 7 = daily or nearly daily. For one drink equivalent to one bottle or can of beer, one glass of wine, or one drink of distilled spirits, usual quantity of alcohol use at a sitting was coded 1 = one drink, 2 = two drinks, 3 = three to four drinks, 4 = five to six drinks, 5 = seven or more drinks. Frequencies of heavy drinking (five or more drinks at a sitting), getting drunk and cigarette, marijuana, cocaine, heroine/opiates, barbiturates/other depressants use were coded 0 = not in the past year, 1 = less than once a month, 2 = once a month, 3 = two to three times a month, 4 = once a week, 5 = two to three times a week, 6 = four to five times a week, 7 = daily or nearly daily, plus a separate code for never having used the drug. An additional set of items assessed problems with alcohol use (Wood, Nagoshi & Dennis, 1992).

For the similarity judgement task, subjects were first shown the list of 16 drug classes and examples in Table 1, and were asked if they understood the kind of drugs that each class referred to. The only further elaborations that were offered in response to subject questions were to refer to major tranquilizers as "anti-psychotic prescription drugs" minor tranquilizers as "prescription sedatives", and anti-depressants as "prescription drugs". Very few subjects asked for any of these elaborations. Each subject was then seated in front of a computer, and told that he or she would be seeing all pairs of these drug classes and should rate how similar, on a scale of 1-7, they felt the two drug classes in a pair were to each other. No indication was given about the features or dimensions on which subjects were to base their similarity ratings. Each subject then received all 120 pairs of drug classes in a self-paced format. Each drug class was always presented with its examples, and a different random order of pairs was generated for each subject.

### Results

Some subjects reported not having used a drug in the past year, although they had previously used it. These included eight for alcohol, 12 for cigarettes, 22 for marijuana and 10 for cocaine. As in the Fabricius *et al.* (1993) study, subjects were classified into groups based on having had any experience with the highest drug in the drug hierarchy. This classification yielded 14 subjects reporting never having used any of the drugs (seven males, seven females), henceforth called abstainers, 19 alcohol users (nine males, 10 females), five cigarette users (two males, three females), 26 marijuana users (five males, 21 females), and 13 cocaine users (five males, eight females). About half the marijuana users and two-thirds of the cocaine users reported cigarette use. In support of the Guttman scaling of the drug use categories (Andrews *et al.*, 1991) only one cocaine user reported not having used alcohol, while all cigarette and marijuana users reported having used alcohol. All cocaine users reported having used marijuana. Finally, only two subjects reported heroin use and four barbiturate use, all of whom were in the cocaine users group.

Given the small number of cigarette users and their similarity in responses to alcohol users in the Fabricius *et al.* (1993) study, this group was combined with the alcohol group for the present analyses. The three non-abstainer groups significantly differed on age of beginning regular alcohol use ( $F(2,58) = 7.20, p < 0.01$ ), with the alcohol user group having started regular drinking at a later age than the other two groups (18.2 years vs. 15.8 for marijuana and 17.3 for cocaine users), but these three groups did not significantly differ on the alcohol problems scale (Wood *et al.* 1992).

### PFNET networks

The Abstainers' PFNET representation is shown in Fig. 1. The bottom left of the figure shows a set of links between alcohol, barbiturates, minor tranquilizers and major tranquilizers, representing a category of sedatives or depressants. This is the only category in the Abstainers' representation that is clearly based on pharmacological properties. Abstainers have no reported personal experience with sedative/depressant drugs, yet they appear to have some understanding of the psychoactive properties of these drugs. The

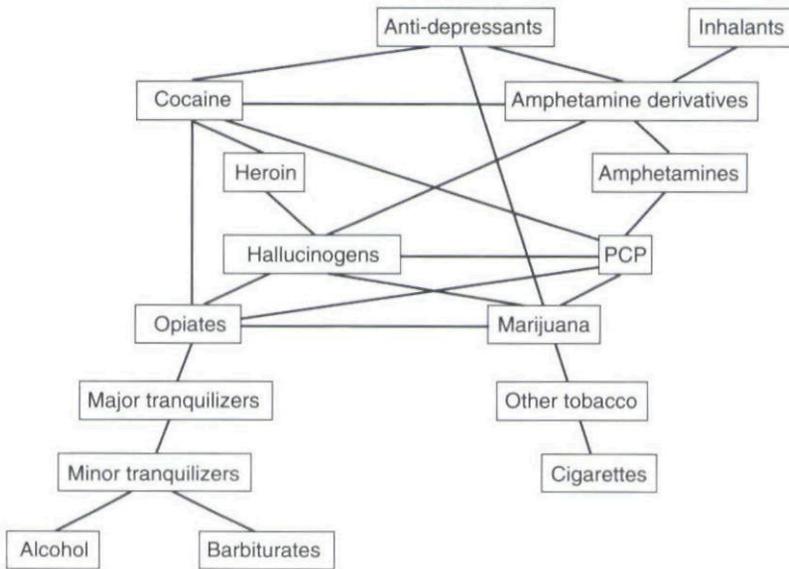


Figure 1. PFNET representation for Abstainers.

bottom right shows a link between cigarettes and other tobacco products that most likely represents a simple tobacco category. The remaining 10 drug classes form an undifferentiated category of mostly illegal drugs which are not distinguished on the basis of the three major pharmacological properties they represent (opiate, hallucinogenic, stimulant). The undifferentiated nature of this cluster is evidenced by the multiple links that several drug classes have to other drug classes. This undifferentiated cluster is connected to the sedative/depressant category through opiates, which suggests Abstainers' conceptualization of opiates as being sedating. The undifferentiated cluster is connected to the tobacco category through marijuana, which may reflect a simple association with method of intake (i.e. smoking).

Alcohol users (Fig. 2) display a much more coherent and differentiated organization than Abstainers. This is evident in the greatly reduced number of links and in the appearance of new categories. Alcohol users continued to show the same sedative/depressant and tobacco categories as Abstainers, but the undifferentiated category of mostly illegal drugs that was evident in Abstainers has now been broken down into a recognizable stimulant category (amphetamine derivatives, amphetamines, and cocaine) and a

hallucinogen category (PCP, hallucinogens), although the hallucinogen category appears to be less well-defined than the stimulant category, because of the multiple links between hallucinogens and other drug classes. Alcohol users have no reported personal experience with stimulant and hallucinogenic drugs, yet they have some understanding of the psychoactive properties of these drugs. They do not, however, show an opiate category (opiates, heroin). Finally, antidepressants are located at the opposite end of the network from the sedative/depressant category, which indicates Alcohol users saw antidepressants as very different from sedatives and depressants.

Marijuana users (Fig. 3) show the same sedative/depressant, tobacco, hallucinogen and stimulant categories as Alcohol users, but they are the first to also show an opiate category (opiates, heroin). Furthermore they locate opioids as transitional between the sedative/depressant and stimulant categories. This is reasonable because opioids are not clearly either sedatives or stimulants. Marijuana users display additional sophisticated understanding of psychoactive effects in the refinements they make to their hallucinogen category, which in addition to being more well-defined now includes inhalants (some hallucinogenic effects). They also appear to

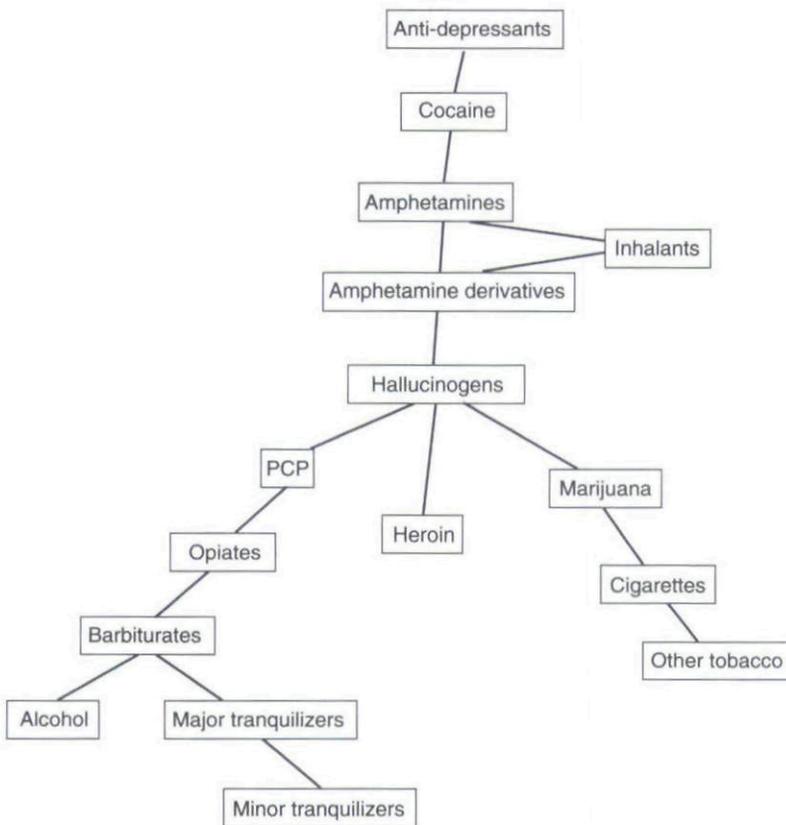


Figure 2. PFNET representation for Alcohol users.

recognize the mixed effects of PCP (hallucinogen + stimulant), since they locate it as a bridge between the hallucinogens and stimulants. Marijuana users have achieved this sophisticated knowledge of stimulants, opioids, and hallucinogens, despite the fact that their drug experience includes only marijuana, alcohol, and (for half of them) cigarettes. Finally, Marijuana users' experience with marijuana was associated with a different location for that drug. They tended to think of it more as a sedative, shown by their linking it with minor tranquilizers, while Alcohol users who had no experience with marijuana linked it with hallucinogens.

Cocaine users (Fig. 4) were very similar to Marijuana users. There was only a minor difference between them, in that Cocaine users linked marijuana with opiates, rather than with minor tranquilizers. Thus the use of cocaine was not

associated with the appearance of any new categories of drugs based on psychoactive properties.

#### Multi-dimensional scaling

The separate PFNETs for each drug use group reported above show that despite the increasing sophistication, there are some features of conceptual structure that appear common across groups. First, the sedative/depressant and tobacco categories present in Abstainers do not disappear as new categories are added in the other drug user groups. Secondly, the sedative/depressant and tobacco categories tend to be located near to each other in all four groups. Finally, among the Alcohol, Marijuana, and Cocaine users at least, a series of links connects the sedative/depressant category at one end to stimulant drugs at the other end of the network.

These similarities between the drug user

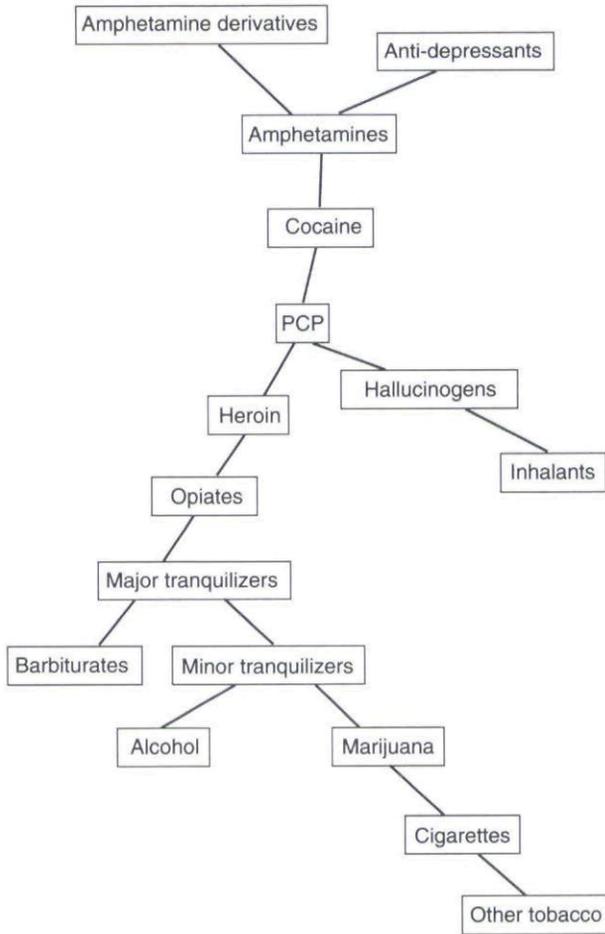


Figure 3. PFNET representation for Marijuana users.

groups detected in the PFNETs suggested that there might be common dimensions along which subjects in the different groups organized drug categories, and that it would be appropriate to enter all four groups into an INDSCAL analysis to examine group differences in the weightings, or importance, accorded to the dimensions. We used the Alsacal program of SAS (SAS Supplemental Users Guide, 1980). The choice of dimensionality for the space was based on several criteria, including goodness-of-fit, the number of items in the stimulus set, the stability of the solution and interpretability (Kruskal & Wish, 1978; Shoben & Ross, 1987). We chose to interpret the two-dimensional solution for the following reasons: (a) with the exception of antidepressants, placement of items remained

stable on the first two dimensions when the third was added, (b) interpretations were readily available for the first two but not the third dimension, (c) the amount of variance accounted for by the third dimension (9%) was much less than accounted for by the first two dimensions (41% and 39%, respectively), and (d) the improvement in fit was substantially greater going from the one- to two-dimensional solution than going from two to three and from three to four dimensions (increase in  $R^2 = 0.189, 0.058$  and  $0.012$ , respectively; decrease in stress =  $0.165, 0.059$ , and  $0.019$ , respectively), (e) the number of items (16) was rather small for a higher-order solution. The two-dimensional INDSCAL accounted for 80.4% of the variance (stress = 0.185) in the similarity ratings of Abstainers, 87.3% of the

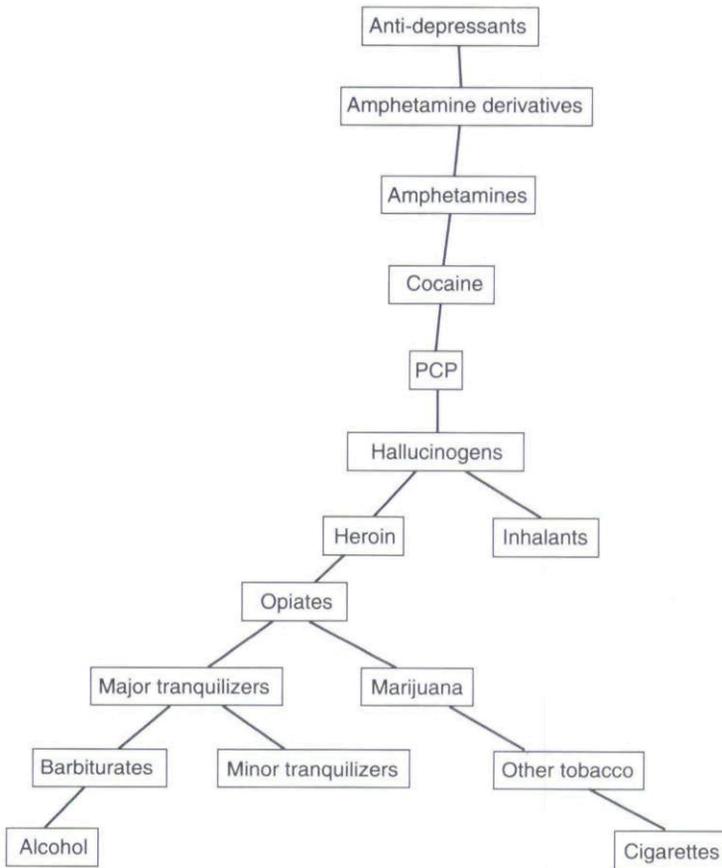


Figure 4. PFNET representation for Cocaine users.

variance (stress = 0.163) for Alcohol users, 88.9% of the variance (stress = 0.153) for Marijuana users, and 78.5% of the variance (stress = 0.211) for Cocaine users. The two-dimensional solution is presented in Fig. 5.

The first dimension is anchored at one end by minimally controlled substances (cigarettes, other tobacco products, and alcohol), and at the other end by those with no legally sanctioned use (heroin, hallucinogens and PCP). Drugs toward the center include those controlled by prescription (tranquilizers, opiates and antidepressants), and those with typically moderate sanctions for use (inhalants and marijuana). Our interpretation is that this reflects a dimension from licit to progressively more illicit drugs. The second dimension is anchored by stimulants (amphetamines, cocaine and amphetamine

derivatives) at one end, and depressants (barbiturates, tranquilizers and alcohol) at the other end. Opiates and heroin, which are not clearly either stimulants or depressants, are located toward the center. This dimension thus appears to be a stimulant-depressant dimension.

The drug use groups differed in the weights they placed on these dimensions, as shown in the weight space depicted in Fig. 6. Abstainers gave more weight to the licit-illicit dimension than to the stimulant-depressant dimension. Alcohol and Marijuana users gave increased weight to the stimulant-depressant dimension compared to Abstainers. However, they maintained the same emphasis on the licit-illicit dimension as the Abstainers, and overall they still gave more weight to that dimension. Cocaine users gave less weight to the licit-illicit dimension than all

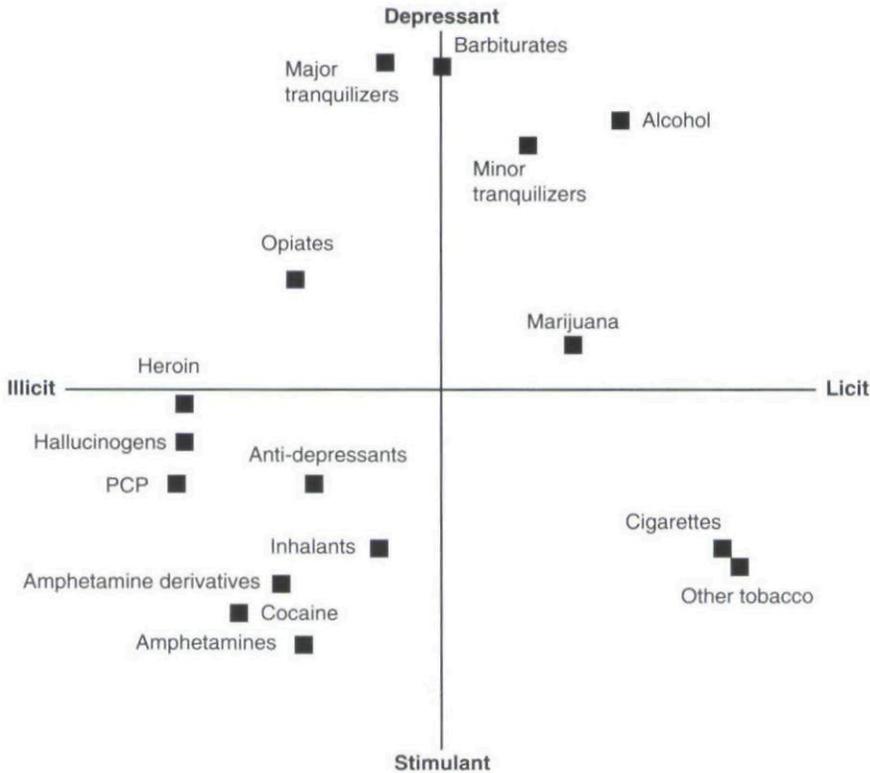


Figure 5. Two-dimensional INDSCAL representation for all four drug user groups.

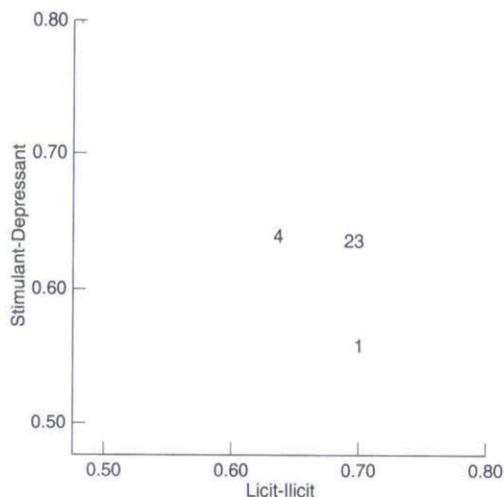
the other groups. This resulted in their weighting the two dimensions equally.

### Discussion

The multi-dimensional scaling and network analyses converged to show that Abstiners had only one pharmacological category involving sedatives/depressants, and that they gave more weight to the licit-illicit dimension than to the stimulant-depressant dimension. Between Abstiners and Alcohol users there were several important differences. In general Alcohol users' understanding of drug classes was much more coherent, differentiated and based on pharmacological properties. Alcohol users constructed two new pharmacological categories (stimulant, hallucinogen) in addition to retaining the sedative/depressant category. Furthermore, they gave increased weight to the stimulant-depressive dimension. Thus they were sensitive to the existence of different pharmacological properties of

drugs they had not used, and how those properties were related along a continuum from stimulant to depressant.

The essential difference between the Alcohol users and the Marijuana users involved increased sophistication in their understanding of pharmacological properties. They showed the same basic structure of the domain as Alcohol users since they weighted the two dimensions similarly. Their increased sophistication was revealed not only in their addition of a new category of opioids and in their clearer definition of their hallucinogen category, but also in a more sophisticated understanding of combinations of psychoactive effects that different drugs can produce. They appeared to understand that opioids are not clearly either sedatives or stimulants, that inhalants have some hallucinogenic effects, and that PCP has both hallucinogenic and stimulant effects. As were Alcohol users, they were sensitive to the existence of different pharmacological properties of drugs they had not used, and how



**Figure 6.** Weights given to the two dimensions of the INDSCAL by the four drug user groups (1 = Abstainers, 2 = Alcohol users, 3 = Marijuana users, 4 = Cocaine users).

those properties were related along a continuum from stimulant to depressant. Finally, while experience with cocaine was not associated with any new categories of drugs, it was associated with a decrease in weight given to the licit-illicit dimension.

These findings both confirm and extend previous research. Even though we included several different drug user groups and a wide range of different drugs, the present study nevertheless yielded dimensions similar to the evaluative (social/positive vs. antisocial/negative) and arousal-sedating dimensions derived for alcohol users' expectancies of alcohol effects in the study by Rather *et al.* (1992). Furthermore, the shift in cognitive weight from the licit-illicit to the pharmacological dimension found for more experienced drug users in the present study parallels the shift in weight from the evaluative to the arousal-sedating dimension in alcohol expectancies between light and heavy adult drinkers in Rather & Goldman (1994) and between second and fifth graders in Dunn & Goldman (1996). This points to a more generalized cognitive process in the progression of individuals to greater drug use than has emerged from the alcohol expectancy literature.

Fabricius *et al.* (1993) found regular differences between drug user groups in beliefs about

harmfulness, and these were repeated in the current study regarding understanding of pharmacological properties. Fabricius *et al.* (1993) proposed a three-part "scenario" relating drug use to changes in beliefs: (a) "There is enough societal information on the effects of alcohol that even abstainers have some differentiated beliefs about alcohol" (p. 63). In the current study, Abstainers' only drug category based on pharmacological properties was the sedative/depressant category containing alcohol. (b) "When people begin to use alcohol, however, it leads to more differentiated beliefs about cigarettes and marijuana. As they increase their alcohol use, it leads not only to lowered concerns about the harmfulness of cigarettes and marijuana but also to beginning differentiation and lowered concerns about cocaine." In the current study Alcohol users had a new category of stimulants, which included cocaine, and they placed increased weight on the stimulant-depressant dimension. They also had a new category of hallucinogens which were not tested in the previous study. (c) "Use of marijuana is then accompanied by highly differentiated beliefs about cocaine." In the current study, Marijuana users showed a new category of opioids, which were also not tested in the previous study, and much more sophisticated understanding of combinations of stimulant, depressive and hallucinogenic effects.

The current results are also highly consistent with the intervention implications of Fabricius *et al.* (1993). Both studies suggest that although interventions targeting abstainers may be effective with messages that imply that all illegal drugs are equivalent in effects and harmfulness, such messages would probably be derided by more experienced drug users who not only have lowered concern and more differentiated beliefs about drug harmfulness, but who also have more sophisticated understanding of the different kinds of psychoactive effects produced by different drugs. However, the current findings add a new dimension to the issue of intervention by demonstrating that drug users who have moved beyond marijuana to cocaine also place less importance on societal norms in their views of drug use. This was apparent in the decreased weight Cocaine users placed on the licit-illicit dimension. Even though Marijuana users appeared as sophisticated in their understanding of pharmacological properties as Cocaine users, they were similar to Abstainers in the importance they

placed on societal norms. Marijuana users are likely to not see themselves as socially deviant, because marijuana use is fairly common, and this would explain why the distinction between licit and illicit drugs continues to be important to them. Cocaine users have used a much more illicit drug, and correspondingly they place less emphasis on the licit-illicit distinction. One implication is that Marijuana users are still likely to base their decision to use other drugs on social norms, whereas Cocaine users' lessened concern with social norms could predispose them toward further drug use. Clearly, then, intervention efforts aimed at those beyond marijuana use may be less effective if they focus on the importance and benefits of engaging in behaviors that conform to societal norms.

While informative, the present study is exploratory and several limitations should be acknowledged. First, the findings are based on descriptive methods without significance tests, and the drug user groups represent only moderate sample sizes. Thus, although the findings are consistent with those of Fabricius *et al.* (1993) in broad outline, more specific replication is needed. Secondly, we presented subjects with a predetermined list of drug categories. This was done to insure that all subjects rated the same stimulus set, and also to limit the size of the set by not having them rate individual drugs. Nevertheless the categories and dimensions that emerged from subjects' ratings may to some degree be dependent on the item we selected. Alternate methods of stimulus selection that should be pursued in future research include having subjects generate items, using other exemplars such as Ritalin (amphetamines) or Zoloft and Paxil (antidepressants), including other categories such as painkillers, and avoiding common terms in category labels, such as "major tranquilizers" and "minor tranquilizers". Replication and extension of the present study could either confirm or lead to alternate interpretations of the categories and dimensions that appeared reasonable to us here. For example, the licit-illicit dimension could turn out to be better characterized as "perceived substance progression" (we are grateful to an anonymous reviewer for this suggestion).

Finally, the cross-sectional design limits what we can say about the changes in cognitions that appear to occur with increasing drug use. Nevertheless, in the absence of longitudinal data, we

can begin to consider what might account for these differences between drug user groups. One possibility considered in Fabricius *et al.* (1993) was that perhaps pre-existing personality differences accounted for both the drugs used by individuals and their beliefs about drug harmfulness. However, there were several arguments against this hypothesis, including the fact that there were no differences in beliefs that could be tracked to cigarette use, even though smokers are known to differ from non-smokers on many personality measures (e.g. Jessor & Jessor, 1977), and that differences in beliefs across groups varied with the drug in question, which would be hard to explain on the basis of global personality traits such as sensation seeking or unconventionality.

The current results also provide evidence against a personality explanation, because differences were detected in more purely cognitive aspects of subjects' views of drugs (i.e. pharmacological properties). Instead, we suggest that there are probably two sources of these differences between drug user groups. One is that any drug use typically results in social exposure to drug users at further stages of drug use. This would provide both information from those users about different psychoactive effects and apparent behavioral evidence of lack of harm from use of those drugs. The second source is likely to be individuals' own experiences with drugs that produce psychoactive effects. Fabricius *et al.* (1993) suggested that experience with alcohol leads to decreased concerns about the harmfulness of marijuana and cocaine because subjects may reason that: "If I can handle alcohol (one psychoactive drug), I can handle marijuana and cocaine (other psychoactive drugs)." Changes in understanding pharmacological properties may similarly result from personal experience with drugs. Experience with some mind-altering states is likely to lead to more ability to imagine other similar and contrasting states, which in turn would provide a conceptual framework within which to assimilate new information about pharmacological properties from others. Cross-cultural extension of these findings would be useful in evaluating not only the degree of universality of the different conceptions, but also in providing information for evaluating the role of personal experience versus societal information about drugs in the construction of these categories.

The findings of both the current study and Fabricius *et al.* (1993) converge to suggest that changes in cognitions about as-yet-unused drugs occur early in the stages of drug use. Alcohol use, in particular, appears to lead to the construction of stimulant and hallucinogenic categories, to an increase in importance attached to the stimulant-depressant dimension, and to decreased and more differentiated concerns about the harmfulness of other psychoactive drugs. These findings suggest that early on in drug behavior sophisticated and interrelated concepts are developing that should be taken into account when designing interventions and information campaigns.

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