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Effects of *d*-Amphetamine in Grouped Versus Isolated Humans

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de WIT, H., M. CLARK AND L. H. BRAUER. *Effects of* d*-amphetamine in grouped versus isolated humans.* PHARMACOL BIOCHEM BEHAV **57**(1/2) 333—340, 1997.—This study was designed to determine whether the subjective, behavioral or physiological effects of a stimulant drug in humans depend on whether subjects are tested under isolated or social conditions. Forty-two subjects were randomly assigned to either the Social (SOC) or Isolated (ISO) condition. SOC subjects participated in 4 h laboratory sessions in groups of 3 or 4, whereas ISO subjects participated in the sessions alone. All subjects participated in three sessions, during which they received capsules containing *d*-amphetamine (10 or 20 mg) or placebo, in mixed order under double blind conditions. Subjective, physiological and behavioral measures were obtained at regular intervals. *d*-amphetamine produced dose-related, prototypic stimulant effects on many measures, including self-reported mood states, behavioral indices and physiological measures. Most of these effects were unaffected by the setting in which subjects were tested (SOC vs ISO). However, body temperature was overall higher in the SOC group, and there was a trend for *d*-amphet-amine to produce greater hyperthermic effects in the SOC group. In addition, 10 mg *d*-amphetamine increased heart rate in the SOC group but not in the ISO group. The results suggest that, like in laboratory animals, some of the effects of stimulants in humans are greater under aggregated conditions. However, unlike in the animal studies, this observed enhancement of the drug's effects under aggregated conditions was limited to physiological measures and did not apply to other subjective or behavioral measures. © 1997 Elsevier Science Inc.

Aggregated Isolated Amphetamine Human Subjective effects Temperature

STUDIES with both laboratory animals and humans indicate that the effects of psychoactive drugs can be influenced by the setting in which the drug is experienced (4,8,32). One aspect of setting which can affect responses to drug is the psychosocial context, including the simple presence or absence of other individuals in the place in which the drug's effects are experienced. Early studies with laboratory animals (4,13) showed that the toxicity of amphetamine in mice increased significantly when the animals were tested in groups compared to animals tested individually. Aggregation has also been shown to increase other effects of *d*-amphetamine, including locomotor activity and hyperthermia (32). Aggregation effects have also been reported with other species and other drugs (e.g., morphine: 31; phencyclidine: 24).

The mechanisms underlying the "aggregate toxicity" phenomenon are not understood. The increased toxicity in grouped animals has been attributed by some to the increased hyperthermic effect (7), but aggregation toxicity has also been reported to occur without hyperthermia (38). The effect is less in animals that have been habituated to grouping (36), suggesting that the novelty of the situation contributes to the effect, perhaps by increasing stress. The phenomenon is unlikely to be related to a pharmacokinetic mechanism, because Lokiec et al. (26) found that the pharmacokinetics of amphetamine in rats were not altered by grouping. Thus it is likely that environmental conditions can interact with the dynamic response to drugs. One possible mechanism is at the level of the catecholaminergic neurons: It has been found that *d*-amphetamine produces more pronounced effects on dopamine and serotonin neurons in the brain in grouped, compared to isolated, animals (5,25,27).

In humans, the subjective and behavioral effects of certain drugs are known to depend on the psychosocial context in which they are experienced (6,29,34). For example, Pliner and Cappell (34) found that normal social drinkers who consumed ethanol in a social setting reported greater increases in friendliness and euphoria and greater decreases in boredom compared to subjects who were socially isolated. Doty and de Wit (8)

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recently found that subjects who were tested in the presence of other subjects reported greater increases in positive mood after ethanol (0.5 or 0.8 g/kg) than subjects who were tested alone. Further, the grouped subjects also consumed more ethanol when they were given the opportunity. Several older studies have also demonstrated similar social facilitatory effects with marijuana (e.g., 21).

It is possible that the enhancement of affective responses to alcohol and other drugs in social settings in humans is due to the same, as yet poorly understood, processes that underlie the aggregation effect in laboratory animals. Whether the "aggregate toxicity" effect of amphetamine observed in animals would occur humans is not known. Anecdotally, there have been reports of unexpected deaths during "rave" parties involving high doses of *d*-amphetamine-like "designer" drugs (11,14). Although these deaths could be related to many other factors (e.g., toxicity of the drugs, contaminants, interactions with other ingested substances, pre-existing medical conditions), they may be related to the phenomenon observed in laboratory animals. Data from animal studies suggest that aggregation not only increases toxicity but may also increase the magnitude of other drug effects. Thus, it is possible that the physiological and subjective effects of low doses of a stimulant might also be greater in grouped, compared to isolated, humans. Because drugs are frequently used in social settings, it is important to determine whether the presence of other individuals, who may or may not also be intoxicated, affects the quality or magnitude of the response.

The enhanced affective responses to drugs observed in humans in social settings may also result from the drugs' direct effects on socialization. Certain drugs, such as amphetamine and alcohol, increase social interactions in humans (e.g. 12,17,35). These effects on sociability or the tendency to socialize may, in turn, influence their reinforcing effects when the drug is administered in a social setting. Alcohol, *d*-amphetamine and secobarbital increase the amount of time subjects spend in social interaction and/or in conversation (12,15,35), and *d*-amphetamine increases subjects' preference for social interactions over money (16,17). In contrast, the effects of diazepam, a drug that does not increase subjects' tendency to socialize, are unaffected by social setting (20). Few studies have examined drug effects on the tendency to socialize in laboratory animals. Interestingly however, one study using dogs (23) found that amphetamine drastically increased the dogs' "need for petting"; that is, it had a "facilitatory effect on behaviors directed to get more than the usual amount of pleasant tactile stimulation". Thus, it is possible that drugs which enhance socialization produce greater positive affect, as well as being more positively reinforcing, when they are administered in a social setting. Thus, for example, subjects may like alcohol more in a social, compared to an isolated, setting because it increases their tendency to socialize: Providing them with the opportunity to socialize thus increases their liking of the drug's effects. If this is the case then another drug, such as amphetamine, which also increases sociability, should also produce more positive affective responses in a social, compared to an isolated, setting.

Finally, another variable that may influence subjective responses to a drug is the setting in which the drug has previously been experienced. For example, social drinkers may enjoy the effects of alcohol more in a social setting because most of their previous experience with alcohol has been in a social setting. The possibility that the context of subjects' prior experience with the drug may influence their responses to the drug can be tested using a drug, such as amphetamine, which increases sociability, but with which subjects do not have extensive associations. The present experiment was designed to test the latter two possibilities by assessing the effects of amphetamine in social and isolated conditions, in individuals who had little prior experience with stimulants. It was hypothesized that subjects tested in the social condition would exhibit stronger and more positive subjective effects of the drug than subjects tested in isolation.

METHODS

Design

This study used a between-subjects design to assess the subjective and behavioral effects of placebo, 10 and 20 mg *d*-amphetamine under isolated (ISO) or social (SOC) conditions. Subjects were randomly assigned to the ISO or SOC group. They participated in three 4 h sessions conducted in the laboratory, in which they received each of the three drug doses under double-blind conditions.

Subjects

Forty-two normal healthy males and females between the ages of 21 and 35 were recruited from the university community, using posters, advertisements, and word-of-mouth referrals. Candidates were initially screened over the telephone. Those who met initial criteria (nonsmokers, consuming at least one alcoholic beverage per week) came to the laboratory for a physical examination, electrocardiogram (ECG), and face-to-face psychiatric interview. Candidates who had serious medical conditions or abnormal ECGs, or who had past or current major Axis 1 disorders [DSMIIIR (1)] were not accepted for the study.

Procedures

Subjects attended an orientation session during which the procedures were explained and informed consent was obtained. Subjects were informed that they might receive a stimulant/appetite suppressant, sedative/minor tranquilizer, antihistamine, or placebo during the study, and that they would be informed of the drug(s) they received after the study. They were instructed not to use drugs, medications or alcohol for 24 h before and after each session, and not to eat or consume caffeine less than one h prior to the session. The study was approved by the University of Chicago Institutional Review Board.

Subjects were randomly assigned to either the SOC condition, in which they were tested in groups of 3–4, or the ISO condition, in which they remained alone during the sessions. Sessions were conducted in one of two rooms ($11 \times 14 \times 10$ ft), furnished like a living room with couches and upholstered chairs, posters on the walls and tv's and reading materials. The temperature in the rooms was centrally controlled at about 72°F. During the sessions subjects in both conditions were permitted to engage in leisure activities such as watching movies or reading. Subjects in the SOC condition had board games and were encouraged to interact socially with their fellow participants. Subjects within each testing group in the SOC condition were not acquainted prior to the study. Subjects in the ISO condition were alone for the duration of the session, except when the experimenter visited briefly to administer questionnaires.

Subjects attended three laboratory sessions, from 0745 until 1215, with a minimum of 48 h between sessions. Upon arrival

at the laboratory at 0745 they completed baseline subjective, physiological and behavioral measures (see below). At 0800 they ingested capsules containing *d*-amphetamine (10 or 20 mg) or placebo with 100 ml of water. These doses have been found to produce modest behavioral effects in previous studies (3). The drugs were administered in opaque capsules with dextrose filler (dextrose alone was used for placebo). They were administered under double-blind conditions, and the order of drug administrations was counterbalanced across subjects. For subjects in the SOC condition, all the subjects in a testing group received the same drug on the same sessions, which was done to maximize the chance of observing an effect in the social condition. Subjective (self-report), physiological and behavioral measures were obtained at 60 min intervals throughout the sessions. At approximately 1215, after the last set of measures, subjects left the laboratory.

Dependent Measures

Subjective effects of the drugs were measured with the 49-item version of the Addiction Research Center Inventory [ARCI; (28)] and several visual analog scales (VAS). The ARCI is a true/false questionnaire that measures drug effects, including stimulant-like effects (Amphetamine [A] and Benzedrine Group [BG] scales), sedative effects (Pentobarbital Chlorpromazine-Alcohol Group [PCAG] scale), euphoria (Morphine-Benzedrine Group [MBG] scale) and dysphoria (Lysergic Acid Diethylamine [LSD] scale). The VAS consists of 100 mm lines associated with various adjectives or descriptors, and subjects indicate their responses from "not at all" to "extremely" on the line according to their current mood or state (feel drug, like drug, feel high, want more drug, anxious, sedated, stimulated, down, high, hungry). Momentary mood states were evaluated with an experimental version of the Profile of Mood States [POMS; (19,30)]. The POMS is a 72-item questionnaire on which subjects rate their mood on a scale of 0 (not at all) to 4 (extremely). The items on the POMS have been factor analyzed to yield 8 scales, Anger, Anxiety, Confusion, Depression, Elation, Fatigue, Friendliness, and Vigor. Two additional scales have been intuitively derived, Arousal [(Anxiety + Vigor)–(Fatigue + Confusion)] and Positive Mood [(Elation–Depression)]. Global drug effects and drug identification were assessed at the end of the session. Subjects rated the overall strength of drug effect on 5-point scale (1 = "I felt no effect at all" to 5 = "I felt a strong drug effect"), and overall liking on a 100 mm visual analog scale. They also attempted to identify the class of drug they received (stimulant, sedative, antihistamine or placebo). These measures are sensitive to the dose-related effects of a variety of drugs, including stimulants, and have been described in detail elsewhere (e.g., 2,10).

Behavioral effects of *d*-amphetamine were measured with the Digit Symbol Substitution Test [DSST; (37)], which is a pencil and paper test of psychomotor performance, and by a computerized test of eye-hand coordination (18,33). In addition, the technician who was conducting the study rated the subjects' behavior on the Observer Rating Form. Subjects' activities (e.g., reading, talking, sleeping) and observable drug effects (e.g., loquacity, restlessness, drowsiness) were scored every hour. Physiological effects were measured using a digital blood pressure and heart rate monitor (Omron Healthcare, Inc., Vernon Hills, IL) and a digital oral thermometer.

Data Analysis

Subjective, physiological, and behavioral variables collected during the session were analyzed with 2 (SOC or ISO group) × 3 (drug condition) × 5 (Hour) repeated-measures

TABLE 1

SUBJECT DEMOGRAPHIC CHARACTERISTICS AND DRUG USE

	Isolated Group (n = 20)	Social Group (n = 22)
Age (mean, sd)	23.7 (3.6)	26.5 (4.8)
Race (n; Asian, Black, White)	3A, 2B, 15W	4A, 3B, 15W
Sex (n; Female, Male)	10F, 10M	11F, 11M
Weight (lbs; mean, sd)	153.5 (26.7)	141.9 (25.5)
Marital status (n; never married)	20	21
Education (n)		
Partial college	9	6
College degree	9	11
Advanced degree	2	5
Full-time student (n)	17	13
Current recreational drug use		
Alcohol (mean; sd; drinks/week)	3.4 (1.5)	3.4 (2.4)
Caffeine (mean; sd; drinks/week)	9.0 (9.7)	5.7 (5.1)
Cigarettes (n; > 2.5 cigs/day)	4	1
Marijuana (n; > 0.5 joints/week)	4	3
Lifetime recreational drug use		
Tranquilizers (n; ever used)	3	1
Stimulants (n; ever used)	4	5
Hallucinogens (n; ever used)	9	7
Marijuana		
Never used (n)	4	4
Used 1–10 times (n)	6	6
Used 10–50 times (n)	3	7
Used > 50 times (n)	7	5

analyses of variance. The results were also analyzed according to subjects' sex. Geisser-Greenhouse degrees of freedom corrections for within-subjects designs were used (22). Alpha levels of $p < 0.05$ were considered significant. The observer ratings of subjects' activities and observable drug effects were analyzed by comparing the number of subjects who were and were not actively socializing, or who exhibited typical stimulant drug effects (i.e., loquacity, restlessness) every h in the three dose conditions. End of session data were analyzed with paired *t*-tests.

RESULTS

Subject Characteristics

The demographic characteristics and drug use histories of the subjects in the two groups are summarized in Table 1. Subjects in the ISO and SOC groups did not differ significantly in age, race, sex, body weight, marital status or education, nor did they differ in their previous recreational use of drugs.

d-*Amphetamine*

d-Amphetamine produced robust and dose-related effects on subjective and mood measures, physiological measures and psychomotor performance (see Table 2). *d*-Amphetamine increased ratings of arousal and positive mood, drug liking, and decreased ratings of hunger. *d*-Amphetamine also increased heart rate and blood pressure and improved psychomotor performance. Representative measures of *d*-amphetamine's effects over time are shown in Fig. 1. This figure shows that *d*-amphetamine dose-dependently increased systolic blood pressure as well as self-ratings of Stimulated (VAS) and Euphoria (MBG scale of ARCI). *d*-Amphetamine also decreased the number of mistakes made on the coordination task, but this effect was not dose-dependent. The drug effects generally peaked 1 or 2 h after administration, and on most measures remained elevated throughout the 4 h session. In the SOC group, both doses of *d*-amphetamine also increased the frequency of social interaction, as rated on the Observer Rating Form (Table 3). Table 3 shows that slightly over half of the subjects in the SOC group were interacting with the other group members at most observation points, and that on placebo sessions the level of interaction declined over the session whereas after *d*-amphetamine social interaction was sustained or increased across the session.

Setting

With several isolated exceptions, social context had little effect on responses to *d*-amphetamine, on measures of subjective effects, physiological responses or psychomotor performance (Table 2). One exception was temperature: Subjects in the SOC condition tended to have a higher body temperature than subjects in the ISO condition, especially during the

TABLE 2

F VALUES (ANOVA) FOR MAIN EFFECTS AND INTERACTIONS INVOLVING DRUG OR CONDITION

Scale	Setting	Drug	Drug × Setting	Hour × Setting	Drug × Hour
ARCI—BG (stimulant-like)		9.6**			2.6
ARCI—PCAG (sedative-like)		4.4			
ARCI—LSD (dysphoria)		6.7*			4.3**
ARCI—MBG (euphoria)		12.1**			7.6**
ARCI—A (stimulant-like)		17.5**			
DEQ—Feel drug		26.6**		3.2	2.7
DEQ—Like drug		4.9*		3.5	
DEQ—High		14.6**			
DEQ—Want more		12.8**			
POMS—Arousal		6.5*			2.7*
POMS—Elation		3.3			6.2**
POMS—Fatigue	9.8*	3.2			
POMS—Positive Mood		3.4			4.6**
POMS—Vigor		5.0*			4.2**
VAS—Anxiety		3.6			3.1*
VAS—High		5.5*			4.7**
VAS—Hungry		4.0			4.9**
VAS—Stimulated		10.5**			6.1**
Coordination task[+]					
Seconds outside circle		4.0			
Number of mistakes		10.0**			
EOS—Overall Liking		6.5**			
Temperature	7.9*			5.8*	3.1*
Systolic blood pressure		46.3**			4.3**
Diastolic blood pressure		16.7**			
Heart Rate		13.5**	4.3*		3.9**

[+]Change from baseline.
Significant at the level of $p < 0.05$, $*p < 0.01$ or $**p < 0.001$.

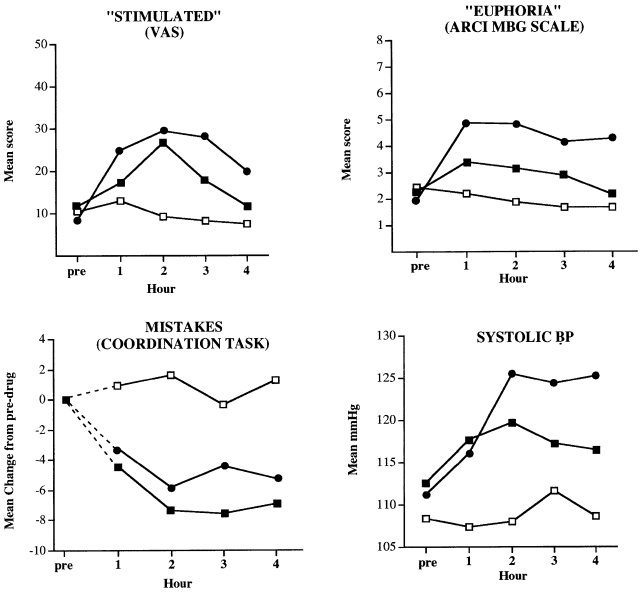

FIG. 1. Mean scores after placebo (open squares), 10 mg *d*-amphetamine (filled squares) and 20 mg *d*-amphetamine (filled circles) on four representative measures for all subjects. The Social and Isolated groups did not differ on any of these measures.

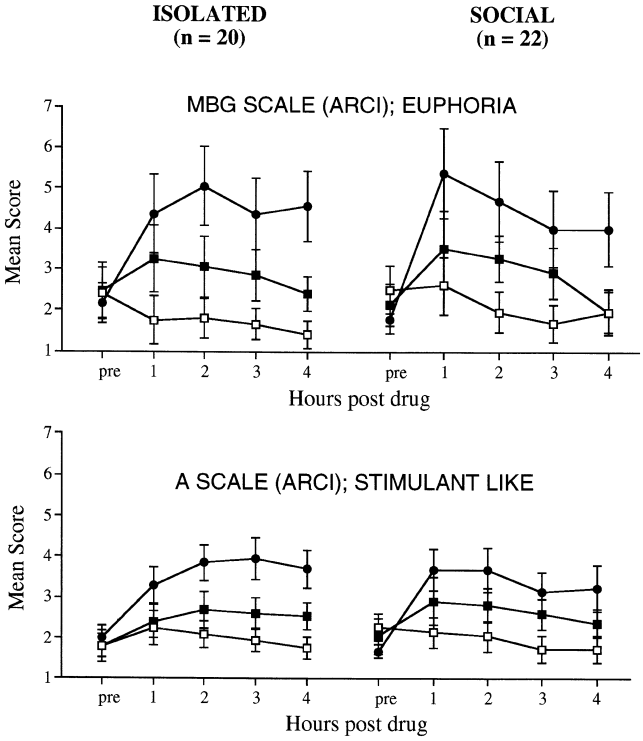

FIG. 2. Mean scores (and SEM) on two representative self-report scales, the MBG and the A scales of the ARCI, for subjects in the Isolated and Social groups, rated hourly after administration of placebo (open squares), 10 mg *d*-amphetamine (filled squares) and 20 mg *d*-amphetamine (filled circles). Amphetamine significantly increased scores on both measures but the scores were not different in the Isolated and Social conditions.

early portion of the session (Fig. 3). In addition, during the last hour subjects in the SOC group showed a marginally greater rise in temperature after *d*-amphetamine than subjects in the ISO group (Condition × Drug, $F = 3.64$, df 1, 40, $p < 0.07$). The SOC and ISO groups also differed in their heart rate responses to *d*-amphetamine (Table 4). At the 10 mg dose, but not the 20 mg dose, subjects in the SOC group exhibited higher heart rates than subjects in the ISO group. SOC and ISO groups also differed on the POMS Fatigue scale, although this effect did not interact with the drug. Surprisingly, Fatigue scores were higher in the SOC condition, compared to the ISO condition (mean SOC 0.70 sd 0.8, mean ISO 0.30 sd 0.5). Finally, SOC and ISO groups differed in their signs of stimulant effects, as measured by the Observer Rating form (Table 5). Table 5 shows that subjects in the SOC group exhibited more signs of stimulant effects (loquacity or restlessness) than subjects in the ISO group, and that these signs increased after administration of *d*-amphetamine.

Analyses by Sex

The data were also analyzed according to the subjects' sex. This analysis revealed several modest main effects and interactions involving sex. Females scored lower on overall ratings of hunger (mean score females 23.5, sd 30.0, males 34.6, sd 26.6) and POMS Arousal (mean score females 0.16 sd 1.6, males 0.74, sd 1.4), and had slightly lower systolic blood pressure (mean females 110.0, sd 15.0, males 120.6, sd 13.6). On the POMS Elation scale and ARCI BG scale, the effects of 20 mg *d*-amphetamine appeared to peak earlier in the males (1 h post drug) than in females (2–4 h post drug. There were no significant interactions between social condition, sex and drug.

TABLE 3

NUMBER OF SUBJECTS (OUT OF 22) IN THE SOC GROUP WHO WERE ENGAGING IN SOCIAL INTERACTION, AT EACH HOUR ON EACH SESSION

Hour	pre	1	2	3	4
Placebo	12	20	14	13	7
10 mg *d*-amphetamine	14	15	17	17	20
20 mg *d*-amphetamine	13	20	21	22	22

DISCUSSION

Contrary to our hypothesis, most of the of the subjective and behavioral effects of *d*-amphetamine were unaffected by the social conditions under which subjects were tested. *d*-Amphetamine produced robust and dose-related stimulant-like effects on a range of subjective and behavioral measures, but these effects were the same whether subjects were in the SOC or the ISO condition. Notably, however, the effects of *d*-amphetamine on body temperature and heart rate differed across the two conditions. Regardless of drug treatment, subjects in the SOC condition had higher body temperatures than subjects in the ISO condition. After treatment with *d*-amphetamine, body temperatures of the SOC subjects were increased to a greater extent than those of the ISO. Although statistically this interaction between the drug and social condition was not robust, this finding is consistent with the finding in laboratory animals (4). Indeed, in laboratory animals the phenomenon of aggregate toxicity has sometimes been attributed to the interactive hyperthermic effects of animals placed in close

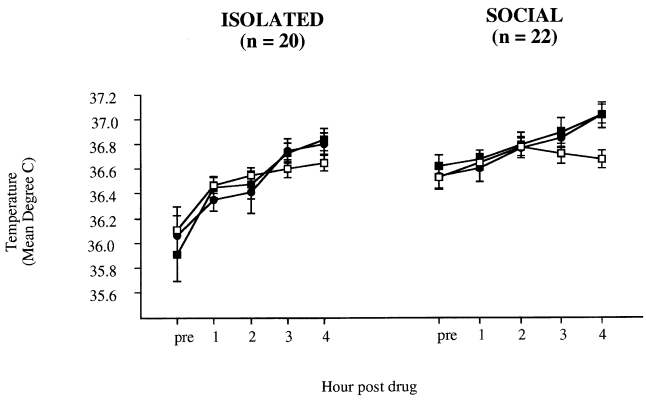

FIG. 3. Mean (and SEM) body temperature in degrees Centigrade in the Isolated and Social groups at hourly intervals after administration of placebo (open squares), 10 mg *d*-amphetamine (filled squares) and 20 mg *d*-amphetamine (filled circles). Temperature was higher in the social condition than in the isolated condition, and amphetamine had a marginally greater effect at hour 4 in the social condition.

proximity and the direct pharmacological effects of the drug (7). Consistent with this, in the present study we also found that body temperature was higher in the subjects tested in the same room, and that the hyperthermic effect of *d*-amphetamine appeared to be greater in the grouped subjects. In the present study, the social setting also appeared to increase the cardiac effects of *d*-amphetamine: 10 mg *d*-amphetamine increased heart rate in the SOC group but not in the ISO group. These findings suggest that more social settings may increase the toxicity of amphetamine and other stimulants, which may account for some of the unexpected deaths among human recreational drug users who use drugs under crowded and stressful conditions (14).

It is somewhat puzzling that the enhancement of response to amphetamine was limited to its effects on temperature, and was not observed with other measures of drug effects (e.g., subjective or physiological). In studies with laboratory animals, aggregation also increases the effects of amphetamine on other responses, including locomotor activity (13,32). It is possible that other response systems might be affected in humans if subjects had been tested under more crowded conditions (e.g., smaller space or more people) or if higher doses of amphetamine had been tested.

d-Amphetamine (10 and 20 mg) produced typical stimulant-like increases in selfreport ratings of positive mood and euphoria (e.g., ratings of drug liking and POMS Elation and Friendliness scores). However, contrary to our expectation based on the previous findings with ethanol (8), these effects of *d*-amphetamine were not affected by the social setting (SOC vs ISO). It is possible that the setting was not sufficiently "social" to simulate a naturalistic recreational setting: Subjects were not acquainted with one another prior to the study, which may have limited their level of interaction. Also, despite our efforts to create a comfortable setting, subjects may have been inhibited in their social behavior because of the laboratory/hospital environment. However, Observer Rating data summarized in Table 3 reveal that subjects were in fact interacting socially at most times, and that the number of subjects interacting increased after administration of *d*-amphetamine (both doses). Another possible reason why the effects of *d*-amphetamine were not affected by the social setting in this study is that it may be necessary for subjects to have prior experience with the drug in a social setting in order for their responses to *d*-amphetamine to be enhanced. An exploratory analysis was conducted with the present results to determine whether subjective responses to *d*-amphetamine (10 or 20 mg) were greater in subjects who had already received the other dose, compared to subjects who were receiving the amphetamine for the first time. Responses to *d*-amphetamine (either dose) were not different in subjects who had, or had not, received a previous dose of amphetamine. Nevertheless, the idea that extended experience with a drug in a social setting enhances response to the drug is a potentially testable idea.

The results of the present study can be considered in light of the three previous studies conducted in this laboratory that have examined the role of social setting in responses to drugs (8,20,39). Johanson and de Wit (20) studied the subjective and behavioral effects of diazepam (20 mg) in normal healthy volunteers who received the drug under social or isolated conditions. Diazepam produced its prototypic sedative effects (e.g., increases in selfreported confusion and fatigue). As in several previous studies (9,19), subjects reported disliking the drug, and did not choose it over placebo under either condition. The effects of diazepam were the same whether subjects were tested under social or isolated conditions. Thus, social setting did not enhance the rewarding effects of a drug with marginal euphorigenic or reinforcing effects. Zacny et al. (39) compared the effects of *d*-amphetamine (20 mg) in subjects who remained alone in a laboratory setting to its effects in subjects engaging in their normal daily activities in their natural weekday environments. Although no differences were found between the two conditions, the settings experienced by the two groups may not have been as dissimilar as the experimenters intended: During debriefing interviews, several subjects in the natural setting group reported that they had engaged in mostly solitary activities (e.g., work in the library or studying at home) even though they were outside the laboratory. The

TABLE 4

MEAN (SEM) HEART RATE, IN BEATS PER MIN, FOR THE ISOLATED AND SOCIAL GROUPS ON PLACEBO AND *d*-AMPHETAMINE (10 AND 20 MG) SESSIONS

	Placebo	10 mg AMP	20 mg AMP
Isolated	64.2 (1.8)	66.6 (1.6)	70.2 (1.8)
Social	65.3 (1.8)	72.4 (2.0)	69.7 (1.6)

Means represent averages across all 5 hourly measures.

TABLE 5

NUMBER OF SUBJECTS IN SOC AND ISO CONDITIONS WHO EXHIBITED SIGNS OF STIMULANT EFFECTS (LOQUACITY OR RESTLESSNESS) AS MEASURED ON THE OBSERVER RATING FORM

	Placebo	10 mg AMP	20 mg AMP
Isolated	0	4	16
Social	7	13	22

Subjects were rated 1, 2 and 3 h after capsule ingestion. Thus, the total possible score in the ISO condition was 60 (3 h × 20 subjects) and in the SOC condition was 66 (3 h × 22 subjects).

most notable demonstration of the ability of social setting to alter responses to a drug has been with ethanol (8). Normal social drinkers received ethanol (0.5 or 0.8 g/kg) either alone or in groups of 3 or 4. Ethanol clearly produced more positive subjective effects in the social condition, and subjects in the social condition also consumed more ethanol when given the opportunity. Taken together with these previous studies, the present results suggests two possibilities, i) that the enhancement of subjective responses in a social environment is specific to ethanol, or ii) that the enhancement of subjective responses to a drug occurs only when the individuals have had some prior experience with that drug in a social setting.

In conclusion, the results of this study provide suggestive evidence that aggregation may have similar effects in humans as it does in animals. On two measures, body temperature and heart rate, *d*-amphetamine produced greater effects in individuals who were grouped together during testing compared to individuals who were tested in isolation. However, this enhancement of the effect of amphetamine was specific to the drug's effects on temperature and heart rate, and did not generalize to either the subjective (i.e., mood-altering) or behavioral effects of the drug.

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