**RESPONSE SUPPRESSION BY VISUAL STIMULI
PAIRED WITH POSTSESSION *d*-AMPHETAMINE
INJECTIONS IN THE PIGEON**

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Responding of pigeons, maintained under a fixed-interval 3-minute schedule of food presentation, was decreased on days that the color of the lights illuminating the food magazine was changed and *d*-amphetamine (1.0 mg/kg, i.m.) was injected after the session. Responding was not decreased by keylight color changes paired with postsession *d*-amphetamine or by postsession injections of saline. Administration of pentobarbital (3.0 to 5.6 mg/kg), but not *d*-amphetamine (.3 to 3.0 mg/kg), before the session increased rates of responding suppressed by drug-paired magazine lights. Responding maintained under a fixed-ratio 30-response schedule was not decreased when differently colored magazine lights were paired with a low (.3 mg/kg) postsession dose of *d*-amphetamine; with high (3.0 mg/kg) postsession doses, however, responding was completely suppressed after two pairings. The effects of pairing magazine stimuli with an intermediate (1.0 mg/kg) postsession dose of *d*-amphetamine depended upon the magnitude of prior postsession doses. After being paired with a low dose, stimuli paired with 1.0 mg/kg did not suppress responding. After being paired with a high dose, stimuli paired with 1.0 mg/kg completely suppressed responding. The suppression of food-maintained responding by stimuli paired with postsession drug administration depends upon both behavioral and pharmacological variables.

Key words: conditioned aversions, punishment, drug-paired stimuli, *d*-amphetamine, pentobarbital, fixed interval, fixed ratio, key peck, pigeons

Conditioned taste aversions refer to the decrease in consumption of a distinctly flavored food that often occurs when initial exposure to that flavor is followed by certain events. For example, consumption of saccharin-flavored water by rats decreased dramatically when initial exposure to that taste was paired, over delays as long as 90 min, with X-irradiation (Garcia, Ervin, & Koelling, 1966). Additional studies have indicated the importance of the particular stimuli by showing that, in rats, novel gustatory stimuli suppressed drinking more than novel auditory and visual stimuli when followed by X-irradiation; however, novel auditory and visual stimuli suppressed drinking more than novel gustatory stimuli

when followed by electric shocks (Garcia & Koelling, 1966). Subsequent studies with quail showed that novel visual stimuli suppressed drinking more than novel tastes when paired with cyclophosphamide injections (Wilcoxon, Dragoin, & Kral, 1971). These findings indicated that novel stimuli can suppress consummatory behavior when paired with certain postsession events, even when relatively long intervals intervene. However, the degree of suppression a novel stimulus can produce may depend upon the length of delay, the species studied, and, depending upon the particular type of postsession event, the specific stimulus employed.

More recent studies have shown that novel stimuli can also suppress schedule-controlled behavior when paired with postsession administration of drugs. In two studies (D'Mello & Stolerman, 1978; Stolerman & D'Mello, 1978) water-maintained responding of rats decreased when distinctive flavors were added to the reinforcer and *d*-amphetamine injections followed those sessions. In another study (Logue, 1980), water-maintained responding in pigeons was suppressed when distinctive colors were added to the reinforcer and initial exposure to that

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colored water had been followed by a lithium chloride injection.

In the present study, responding of pigeons was maintained by food presentation and different visual stimuli were occasionally paired with postsession *d*-amphetamine injections. Responding progressively decreased when the color of the light illuminating the food magazine was changed on days when *d*-amphetamine was given after the session. Because *d*-amphetamine typically increases low rates of responding except when responding is directly suppressed by its consequences (McKearney & Barrett, 1978), this suppression was examined further by giving *d*-amphetamine before sessions with drug-paired stimuli. Pentobarbital was also studied since, in contrast to *d*-amphetamine, this drug usually increases suppressed responding (McKearney & Barrett, 1978). Finally, the effects of different postsession doses of *d*-amphetamine were examined in an effort to determine the contributions of dose levels and prior drug experience to the suppression of responding by drug-paired stimuli.

GENERAL METHODS

Subjects

Six male White Carneaux pigeons, obtained from the Palmetto Pigeon Plant, were maintained at 80% of their free-feeding weights throughout the experiment by supplemental postsession feeding. Two pigeons (P-110 and P-137) had a prior history of drug administration; both had been given pentobarbital and *d*-amphetamine no sooner than 12 months prior to the current study. Each pigeon was housed individually with water and grit continuously available.

Apparatus

A single-key experimental chamber modeled after the one described by Ferster and Skinner (1957) was enclosed in a sound-attenuating box provided with continuous white noise. A response key (Gerbrands) was centered on the front wall of the chamber, 22 cm above the floor. The key could be transilluminated by pairs of red, white, or blue lights. Pecks on the key exceeding a force of 15 g (.15 N) were recorded as responses and operated recording and programming equipment. In addition, each peck produced an audible click of a feed-back relay mounted on the front wall of the

chamber. A rectangular opening, horizontally centered 15 cm below the key, allowed access to mixed grain. Two clear 120-V 60-Hz ac 7-W lamps were located approximately 15 cm above the opening. During food presentation (4 sec), both the grain magazine and the magazine lamps were operated and the keylight was turned off. Data were collected on impulse counters, running time meters, and cumulative response recorders.

Drugs

d-Amphetamine sulfate and pentobarbital sodium were dissolved in .9% saline solution and injected (i.m., pectoral muscle) in a volume equivalent to 1.0 ml/kg of body weight. Doses are expressed as the total salt.

EXPERIMENT 1

The first experiment examined the effects of pairing different visual stimuli with postsession *d*-amphetamine administration.

METHOD

Subjects

P-1210, P-2408, P-5486, and P-6725 served.

Procedure

The pigeons were trained to key peck by the method of successive approximations (Ferster, 1953). The response requirement was gradually increased from 1 to 30 responses, changed briefly to a 90-sec variable-interval schedule, and then to a 90-sec fixed-interval (FI) schedule. The interval was then increased to 3 min. Under the final training conditions, in the presence of a white keylight, the first key peck after 3 min produced grain. Sessions ended after 20 grain presentations or 90 min, whichever came first.

The effects of postsession saline injections were assessed first for 5 to 7 consecutive sessions. Immediately after each of these sessions the pigeon was withdrawn from the chamber, injected with a .9% saline solution (1.0 ml/kg of body weight) and then replaced in the chamber for 5 to 10 min. The effects of pairing novel visual stimuli with postsession *d*-amphetamine were then determined. On certain days the color of a visual stimulus that normally occurred during a session was changed and 1.0 mg/kg *d*-amphetamine was given immediately after those sessions (*d*-amphetamine session);

on all other days the color of these stimuli was the same as it had been during training and saline was given after those sessions (saline session). The postsession injection procedure for *d*-amphetamine was similar to that described earlier for saline. Different stimuli were initially studied with each pigeon. For P-1210, the keylight was blue during the first and subsequent days with postsession *d*-amphetamine (keylight change). For P-2408, on days with postsession *d*-amphetamine, each 15th response during the interval produced a brief (1.0 sec) change in the color of the keylight from white to blue (brief keylight change); this response requirement reset at the beginning of each interval. For P-5846, the clear lights over the grain magazine hopper were replaced with yellow bulbs before each session that was followed by a *d*-amphetamine injection (hopper light change). For P-6725, both the keylight color (from white to blue) and the hopper light color (from clear to yellow) were changed on days with postsession *d*-amphetamine (keylight and hopper light change). Stimuli paired with postsession *d*-amphetamine were studied during 6 to 7 of the next 12 to 15 sessions.

In a second phase of the experiment, two of the previous stimulus conditions were selected for further study. For two pigeons (P-1210 and P-2408), postsession *d*-amphetamine followed sessions with a blue keylight and yellow hopper lights. With the other two pigeons (P-5846 and P-6725), *d*-amphetamine followed sessions with yellow hopper lights (the same stimulus conditions studied previously with P-5846). These stimulus pairings were studied during 5 to 6 of the next 19 to 20 sessions. Daily sessions ended after 10 food presentations or 45 min, whichever came first.

In a third phase of the experiment, the effects of pre-session treatment with pentobarbital (1.0 to 10.0 mg/kg) and *d*-amphetamine (.3 to 3.0 mg/kg) were studied during sessions with drug-paired stimuli. Experimental conditions were the same as those employed in the second phase for P-5846 and P-6725; only those pigeons were used. Yellow hopper lights and postsession *d*-amphetamine occurred during sessions each Tuesday and Friday; during all other sessions, food presentation was accompanied by clear hopper lights and saline was given after the session. Pre-session drug treatment occurred only on Fridays; pre-session effects of *d*-amphetamine were studied first.

Doses of each drug were studied in a mixed sequence.

RESULTS

Figure 1 shows rates of responding during sessions where different visual stimuli were paired with postsession *d*-amphetamine injections (*d*-amphetamine sessions) and those during sessions without stimulus changes (saline sessions). Under the keylight condition (P-1210), responding during the six *d*-amphetamine sessions was similar to that of saline sessions. Under the brief keylight change condition (P-2408), responding decreased slightly during the second and third *d*-amphetamine session, but during subsequent *d*-amphetamine sessions responding was similar to that during saline sessions. Under the hopper light change condition (P-5846), responding decreased slightly after the first pairing and rates of responding during subsequent *d*-amphetamine sessions were generally lower than those during saline sessions. Under the keylight and hopper light change condition (P-6725), responding during successive *d*-amphetamine ses-

Fig. 1. Rates of responding maintained under fixed-interval 3-min schedules of food presentation in pigeons when saline or 1.0 mg/kg *d*-amphetamine was given immediately after the session. For saline sessions (unfilled circles) the keylight was white and the hopper lights were clear. For *d*-amphetamine sessions certain visual stimuli were changed for each pigeon; unfilled squares and filled squares, circles, and triangles represent changed keylight, hopper light, brief keylight and hopper light plus keylight during *d*-amphetamine sessions, respectively. Abscissa, consecutive sessions; ordinate, session response rate. The vertical dashed line divided the first and second phase of Experiment 1; at that point the stimuli occurring during *d*-amphetamine sessions were changed for 3 of the 4 pigeons and sessions were changed from 20 to 10 food presentations.

sions decreased progressively until suppression was almost complete.

Rates of responding during the second phase of the experiment are shown on the right side of Figure 1. During sessions in which both key-light and hopper-light stimuli were followed by postsession *d*-amphetamine (P-1210 and P-2408), responding during *d*-amphetamine sessions was not consistently different from that during saline sessions. When hopper lights were paired with postsession *d*-amphetamine, responding during *d*-amphetamine sessions either gradually decreased below saline levels (P-5846) or was completely suppressed (P-6725); for P-6725, responding during saline sessions was initially decreased also but gradually increased to levels seen at the beginning of the experiment. With most pigeons, responding was occasionally decreased during saline sessions immediately following *d*-amphetamine sessions. During this phase of the experiment, the combined change in keylight and hopper-light colors had no effect when paired with postsession *d*-amphetamine (P-2408), whereas pairing hopper lights alone with postsession *d*-amphetamine consistently suppressed responding (P-5846 and P-6725).

Figure 2 shows cumulative response records for both pigeons when responding was maintained under the FI schedule of grain presentation during saline sessions (a) and *d*-amphetamine sessions (b). During *d*-amphetamine sessions, responding occurred for the first few intervals, then abruptly stopped for the remainder of the session.

Presession drug effects. Once established, the suppression of responding by stimuli paired with the postsession administration of 1.0 mg/kg *d*-amphetamine was reliably obtained during sessions with those stimuli (compare Figure 1 with C, Figure 3). Responding on other days, without drug-paired stimuli, was similar to that which occurred before exposure to those stimuli. The effects of presession administration of *d*-amphetamine on responding suppressed by these stimuli are shown in both the cumulative response records of Figure 2 (Panel c) and in the dose-response curves of Figure 3. Across a wide range of doses (.03 to 3.0 mg/kg) presession *d*-amphetamine did not change overall rates of suppressed responding even though slight increases in responding during the initial intervals of a session occasionally occurred. Presession treatment with *d*-amphetamine had

no effect on the continued ability of drug-paired stimuli to suppress responding (C, Figure 3) nor did presession treatment affect non-suppressed performance (B, Figure 3).

Effects of presession pentobarbital on responding suppressed by stimuli paired with postsession *d*-amphetamine are shown in both the cumulative response records of Figure 2 (Panel d) and the dose-response curves of Figure 3. In contrast to *d*-amphetamine, pentobarbital increased responding that was suppressed by stimuli paired with postsession amphetamine. For both pigeons, 1.0 mg/kg pentobarbital had little effect but 3.0 mg/kg substantially increased rates of responding; responding was increased to a greater extent with 10.0 mg/kg in P-6725. Larger doses of pentobarbital increased responding less (P-6725) or not at all (P-5846).

Presession treatment with pentobarbital did not affect performances during saline sessions; however, response suppression during *d*-amphetamine sessions was temporarily attenuated after high doses of pentobarbital had been given. Panel e of Figure 2 shows performances during the first session with drug-paired stim-

Fig. 2. Cumulative response records for P-5846 and P-6725 when responding was maintained under FI 3-min schedules of food presentation during saline sessions (a) and when yellow hopper lights occurred during *d*-amphetamine (1.0 mg/kg i.m., post-session) sessions (b). Lower frames show the effects of presession treatment with .3 mg/kg *d*-amphetamine (c) and 3.0 mg/kg pentobarbital (d) on responding during *d*-amphetamine sessions. The lowest panel shows responding during the first *d*-amphetamine session to follow one in which the effects of a high dose of pentobarbital had been assessed (e). Abscissa, time; ordinate, cumulative responses. The pen reset after food presentation.

Fig. 3. Rates of responding during saline (B) and post-session *d*-amphetamine (C) sessions, and dose-response curves for pre-session amphetamine and pentobarbital during post-session *d*-amphetamine sessions. Responding was maintained in pigeons under an FI 3-min schedule of food presentation. Saline data are from Thursdays, post-session *d*-amphetamine data are from Tuesdays, pre-session drug effects were determined on Fridays. Doses were determined at least twice. Abscissa, dose; ordinate, rate of responding (vertical bars describe 1 S.D.).

uli to follow sessions with high doses of pentobarbital (5.6 mg/kg with P-5846 and 10.0 mg/kg with P-6725). The degree of suppression previously seen during *d*-amphetamine sessions (i.e., Panel b) was not obtained until later in the session.

DISCUSSION

Novel stimuli paired with post-session *d*-amphetamine injections suppressed schedule-controlled responding in pigeons. However, not all novel stimuli were equally effective when paired with post-session *d*-amphetamine. Keylight colors alone, whether intermittently or continuously changed during *d*-amphetamine sessions, did not suppress responding. Hopper lights, especially in combination with keylights, were more effective in suppressing responding when paired with post-session *d*-amphetamine. These findings are similar to those of Logue (1980) who found that novel colors added to the reinforcer suppressed responding in pigeons more than novel colors on the response key when initial exposure to each stimulus was followed by lithium chloride injections.

When keylights did not suppress responding in the present experiments, subsequent attempts to suppress responding in the same

birds with combined keylight and hopper-light stimuli paired with *d*-amphetamine were without effect (P-1210 and P-2408). This is consistent with previous reports showing that prior experience with a drug can attenuate or even prevent suppression by stimuli that are later paired with that drug (Cappell, LeBlanc, & Herling, 1975; Goudie & Thornton, 1975; Vogel & Nathan, 1976). An alternative explanation would be that the effects of prior pairings may influence the ability of other stimuli to suppress responding.

The suppression of responding by amphetamine-paired stimuli was attenuated by pre-session pentobarbital but not *d*-amphetamine. Although the highest doses of pentobarbital attenuated suppression less than intermediate doses, this probably resulted from the direct rate-decreasing effects of those doses on behavior rather than a diminished ability to antagonize the suppression.

Both pentobarbital and chlordiazepoxide have previously been shown to attenuate conditioned taste aversions produced by *d*-amphetamine (Cappell & LeBlanc, 1973; Cannon & Freda, 1980; Riley & Lovely, 1978). Interestingly, these drugs also increase responding suppressed by the response-dependent (Geller & Seifter, 1960; Goldberg, 1980; Speelman, 1979; Valentine & Barrett, 1981) and response-independent (Miczek, 1973) delivery of a wide variety of stimuli. These similar rate-increasing effects of the sedative-hypnotic compounds on responding suppressed by such diverse means suggest some common functional properties of behavioral suppression, regardless of the manner in which that suppression is produced.

EXPERIMENT 2

The second experiment examined the effects of hopper-light stimuli on responding when the post-session dose of *d*-amphetamine was systematically changed. In addition, a fixed-ratio rather than a fixed-interval schedule was used.

METHOD

Subjects

Pigeons P-110 and P-137 served. Each had previously responded under concurrent variable-interval schedules of grain presentation and required no subsequent training.

Apparatus

An experimental chamber, similar to that used in Experiment 1, was equipped with pairs of both white and yellow lights over the hopper. Each pair could be independently operated during food presentation.

Procedure

Responding was maintained under a fixed-ratio 30-response schedule of grain presentation. In the presence of a blue keylight, each 30th key peck produced grain. A 5-sec timeout, during which all lights were turned off and responding had no scheduled consequences, followed food presentation. Normally, white lights accompanied grain presentation and no injection followed the session; on certain days, usually Tuesdays and Fridays, yellow lights accompanied food presentation and *d*-amphetamine was given after these sessions. Sessions ended after the 30th grain presentation or 30 min, whichever occurred first.

Postsession doses of 1.0 mg/kg *d*-amphetamine were studied first. Subsequently, several doses were studied, each for a series of pairings until its effects were consistent. The postsession dose was then either increased or decreased within the range .3 to 3.0 mg/kg. For P-110 the sequence of doses studied was 1.0, 2.0, .3, 1.0, 3.0, 1.0, and then .3 mg/kg. For P-137 the sequence was 1.0, 2.0, 3.0, 1.0, .3, and then 1.0 mg/kg.

RESULTS

The fixed-ratio 30-response schedule maintained rates of responding near 2.0 responses per second in both pigeons. Figure 4 shows rates of responding for both *d*-amphetamine sessions and those without drug-paired stimuli; the degree of suppression during *d*-amphetamine sessions was directly related to the magnitude of the postsession dose. When stimuli paired with a postsession dose of 1.0 mg/kg appeared to have only moderate rate-decreasing effects, the postsession dose was increased. Responding of both pigeons was suppressed to varying degrees by stimuli paired with 2.0 mg/kg; for P-110 responding was completely suppressed by the 5th session with yellow hopper lights, whereas for P-137 rates of responding decreased approximately 50% by the 3rd day of exposure. Both for P-110, when the postsession dose was decreased to .3 mg/kg and

Fig. 4. Rates of responding maintained under fixed-ratio 30-response schedules of food-presentation in pigeons during control (unfilled circles) and *d*-amphetamine (see figure for dose, i.m., postsession) sessions. Abscissa, sessions; ordinate, rate of responding. Control session data are from Thursdays; *d*-amphetamine session data are from Tuesdays and Fridays.

then systematically increased and decreased, and for P-137, when the dose was first increased to 3.0 mg/kg and then decreased and increased, responding was always suppressed by the second *d*-amphetamine session to be followed by 3.0 mg/kg. In addition, when the postsession dose was decreased to .3 mg/kg, responding that had been suppressed by stimuli paired with higher doses of *d*-amphetamine always recovered to rates similar to those in sessions without drug-paired stimuli. The effects of stimuli paired with 1.0 mg/kg, however, depended upon the dose of *d*-amphetamine that had been given during the series immediately before. Following .3 mg/kg, stimuli paired with 1.0 mg/kg did not suppress responding; following 3.0 mg/kg, responding remained suppressed when the postsession dose was lowered to 1.0 mg/kg.

Figure 5 (left panel) shows cumulative response records of performances under the fixed-ratio 30-response schedule during a session without drug-paired stimuli; responding typically occurred at a high sustained rate throughout the entire session. Figure 5 (right panels) shows responding for *d*-amphetamine sessions with 1.0 mg/kg postsession doses that followed a series of *d*-amphetamine sessions with 3.0 mg/kg postsession doses. Responding was completely suppressed after the first few

Fig. 5. Cumulative response records for P-110 and P-137 when responding was maintained under a fixed-ratio 30-response schedule of food presentation. Left frames (a), control session; right frames (b), a *d*-amphetamine session (1.0 mg/kg i.m., postsession) that followed a series in which 3.0 mg/kg had been given postsession. Abscissa, time; ordinate, cumulative responses. The pen reset at the end of a session; food presentation was marked by a downward deflection of the response pen.

food presentations in a manner quite similar to that seen during the 3.0 mg/kg postsession dose series.

DISCUSSION

Suppression of responding by amphetamine-paired stimuli was related to the magnitude of the postsession dose. Although stimuli paired with postsession doses of .3 mg/kg only transiently affected responding, stimuli paired with larger postsession doses usually suppressed responding completely after the first few pairings. Similar relationships between dose and the decrease in drinking produced by amphetamine-paired gustatory stimuli have been reported for rats (Cappell & LeBlanc, 1973; Nathan & Vogel, 1975). Because prior exposure to a drug can modify the suppressive effects of stimuli paired with that drug (Vogel & Nathan, 1976), repeated pairings with different doses in individual subjects might be expected to modify the initial effects of that stimulus. Indeed, in the present study the effects of stimuli paired with 1.0 mg/kg *d*-amphetamine did vary. When stimuli paired with 1.0 mg/kg were assessed immediately after pairings with

a lower dose, responding was not suppressed. However, the opposite effect was not expected; when those same stimuli were assessed after pairings with a higher dose, responding was suppressed. Thus, the minimal effective suppressive dose could vary over a three-fold range.

GENERAL DISCUSSION

In this experiment the schedule-controlled responding of pigeons was suppressed by visual stimuli paired with food delivery and with the postsession injection of *d*-amphetamine. The suppression of responding depended upon the specific stimuli employed, the history of stimulus pairings, and both the prior and current dose of *d*-amphetamine paired with that stimulus. The findings of Experiment 1, in which the lights illuminating the magazine were more effective in suppressing responding than other stimuli (e.g., a distinctive keylight color), are consistent with other work which generally indicates that certain types of stimuli are more effective in suppressing responding than others (Garcia & Koelling, 1966; Logue, 1980). Based on the present study, it would appear that stimuli temporally or contiguously correlated with the presentation of food produce more immediate and reliable suppression of schedule-controlled responding than stimuli either temporally or spatially more distant from food presentation.

The results of Experiment 2 suggest that the suppression of schedule-controlled responding by amphetamine-paired stimuli is dose-dependent. This has also been shown for consummatory behavior (Cappell & LeBlanc, 1973; Nathan & Vogel, 1975). In addition, the present experiments also demonstrated that stimuli effective in suppressing responding need not be completely novel. Stimuli paired with larger doses suppressed responding to the same extent both before and after pairings with lower doses that did not suppress responding. The effects of stimuli paired with marginally effective doses depended on prior pairings. Although stimuli paired with a dose of 1.0 mg/kg amphetamine did not suppress responding after pairings with .3 mg/kg, they produced marked and enduring suppression after a series of sessions in which they were paired with 3.0 mg/kg. Thus, although prior experience with nonpaired drug administration can preclude

or attenuate suppression (Cappell, LeBlanc, & Herling, 1975; Vogel & Nathan, 1976), prior experience with drug-paired stimuli can also accentuate suppression. The suppression of responding by stimuli paired with 1.0 mg/kg following exposure to stimuli paired with 3.0 mg/kg was durable and persisted until the dose was decreased to .3 mg/kg. Thus, stimuli paired with the 1.0 mg/kg dose either had no effect or produced a marked suppression depending on preceding conditions.

Stimuli paired with drug injections can have different effects. Rather than suppress responding, as in the present study, the presentation of stimuli paired with psychomotor stimulants can increase and sustain responding under other conditions (Katz, 1980; Spealman & Goldberg, 1978). Both amphetamine and nicotine have been shown to increase or decrease responding depending on precisely how it was arranged to occur with regard to behavior (Goldberg & Spealman, 1982; Wise, Yokel, & DeWit, 1976). The importance of the schedule of reinforcement in maintaining or suppressing behavior has been discussed extensively with regard to both schedule-controlled behavior (Morse & Kelleher, 1977) and conditioned taste aversions (Goudie, 1979).

Responding suppressed by stimuli paired with the postsession injection of *d*-amphetamine was increased by the administration of pentobarbital before the session; however, pre-session administration of *d*-amphetamine had no effect or only decreased responding further. Although amphetamine typically increases low rates of responding under a wide variety of conditions, responding suppressed by response-produced noxious stimuli is usually unaffected or decreased by *d*-amphetamine; sedative-hypnotic compounds, however, such as pentobarbital and chlordiazepoxide, typically increase punished behavior (Kelleher & Morse, 1968; McKearney & Barrett, 1978). Previous research using a stimulus paired with response-independent shock has also shown that responding suppressed by these conditioned stimuli is not increased by *d*-amphetamine but is by chlordiazepoxide (Valentine & Barrett, 1981). Previous research has also shown that sedative-hypnotics attenuate the suppression of consummatory responses by amphetamine-paired stimuli (e.g., Cappell & LeBlanc, 1973; Concannon & Freda, 1980; Riley & Lovely, 1978). However, when drug-paired stimuli have main-

tained responding, *d*-amphetamine can increase that behavior (e.g., Katz, 1980). Thus, as has been emphasized repeatedly, the behavioral effects of drugs (e.g., Kelleher & Morse, 1968; McKearney & Barrett, 1978) depend both on how the particular behavior under study has been developed and how it is currently being controlled by the environment.

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