Effects of response elimination procedures upon the subsequent reacquisition of autoshaping

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In Experiment 1, three groups of pigeons were autoshaped and then administered one of three different response-elimination procedures. Group TRC (truly random control) and Group Backward (backward conditioning) ceased responding more rapidly than Group CS-only. In a subsequent reacquisition test with a novel CS, Groups TRC and Backward were retarded relative to Group CS-only. In Experiment 2, the CS-only and TRC response-elimination treatments were not differentially effective in extinguishing the response. The treatments were followed either by five sessions of unpredictable US presentations (US-only) or by five sessions of remaining in their home cages (hold) prior to the reacquisition test. The TRC treatment retarded reacquisition relative to the CS-only treatment; the US-only posttreatment manipulation failed to reliably retard reacquisition relative to Hold, although retarding effects of US-only are discernible in a block-by-block analysis. Applications and limitations of a context-blocking account of these results are discussed.

Although autoshaping is reliably observed when key illumination is followed by the presentation of food, a number of pretraining manipulations have been shown to interfere with the acquisition of the keypecking response. These pretraining manipulations include an uncorrelated relationship between the autoshaping CS and the US (Gamzu & Williams, 1971, 1973; Mackintosh, 1973; Wasserman, Franklin, & Hearst, 1974; Tomie, Murphy, Fath, & Jackson, 1980), an uncorrelated relationship between a stimulus other than the autoshaping CS and the US (Hall & Honig, 1974; Tomie, 1976a, 1976b, 1980), and intermittent unsignaled US presentation when there is no CS presented (Downing & Neuringer, 1974; Engberg, Hansen, Welker, & Thomas, 1972; Tomie et al., 1980; Schwartz & Balsam, Note 1). It is important to note that all of these pretraining manipulations expose the subject to unpredictable presentations of the US.

To account for these retardation effects, investigators have proposed several transfer-of-training mechanisms. Mackintosh (1973) has suggested that "learned irrelevance" may account for the retardation

that occurs following pretraining where the autoshaping CS is randomly related to the US. Similarly, Hall and Honig (1974) have explained the retardation of autoshaping which occurs following uncorrelated houselight-food presentations in terms of "general inattentiveness." Finally, Engberg et al. (1972) have suggested that the deleterious effects of unsignaled, response-independent US presentations upon subsequent autoshaping can be explained in terms of "learned laziness." While the particulars of each of these accounts differ, they share the premise that the retarded acquisition of autoshaping is a general transfer-of-training effect and is a by-product of the associative impairment engendered by pretraining involving unpredictable food.

Recently, Tomie (1976a, 1976b, 1980) has offered an alternative interpretation of these retardation effects which is based on the "blocking" phenomenon reported by Kamin (1969). Kamin noted that conditioning to a novel CS was retarded if that CS was compounded with another CS_x which had been previously conditioned to the US. Moreover, subsequent research has indicated that the magnitude of the blocking effect is directly related to the amount of conditioning that is accrued to CS_x prior to the introduction of the novel CS.

According to the blocking analysis of these retardation effects, the static contextual stimuli present in the conditioning environment during pretraining are conditioned during pretraining, due to their pairing with unsignaled US presentations. This excitatory context is then compounded with the illuminated-key

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CS during the autoshaping test, where it exerts a blocking influence that results in the retardation of acquisition.

The majority of the empirical support for the context-blocking interpretation comes from experiments that utilize context-shift designs. For example, in one such experiment (Tomie et al., 1980), two groups of pigeons received extensive pretraining consisting of intermittent, unsignaled US presentations. One group, designated the NO CONTEXT CHANGE group, received this pretraining in the presence of the contextual stimuli that would be present during the acquisition test. The CONTEXT CHANGE group, on the other hand, received pretraining in the presence of contextual stimuli different from those which would be present during the autoshaping test. When both groups were subsequently tested for acquisition, the NO CONTEXT CHANGE group was found to be retarded in the acquisition of autoshaping relative to the CONTEXT CHANGE group.

If pairing of the context with food leads to the development of an excitatory context, then the presentation of the context in the absence of food ought to extinguish its excitatory properties. Since a context without excitatory properties should be ineffective as a blocking stimulus, one would expect that the retardation of autoshaping following pretraining with unpredictable food would be alleviated by interpolating nonreinforced context exposure between pretraining and testing. Such a result has been reported by Tomie (1976b, Experiment 2).

It therefore appears that context control is acquired by pairings of unsignaled food with the context and that context control is extinguished by presentation of the context in the absence of food. The present experiment asks the question: Are these acquisition and extinction procedures effective in modulating the *reacquisition* of the autoshaping response to a novel CS? In the present experiment, following initial autoshaping, keypecking was eliminated by two procedures (the truly random control—TRC—and backward conditioning) that retained the US and by one procedure (CS only) in which the US was absent. From a context-conditioning analysis, it might be expected that the presence of unsignaled USs (in the TRC and backward-conditioning groups) during the response-elimination phase may condition the static contextual cues, thereby retarding the reacquisition of autoshaping to a novel CS. The CS-only treatment, on the other hand, provides for extensive nonreinforced exposure to the context, which should minimize its blocking capability.

EXPERIMENT 1

Method

Subjects. The subjects were 36 experimentally naive adult pigeons obtained from a local supplier and maintained at 75% of their ad-lib weights throughout the experiment. The subjects were

housed in individual metal cages and given free access to grit and water. A 12-h light-dark cycle was in effect in the colony room.

Apparatus. Four standard pigeon chambers were used, with associated automatic programming and recording equipment. The chamber measures 35 × 35 × 30 cm (L × W × H); a metal intelligence panel on the front contained a 2.9-cm-diam pecking key centered 20 cm above a wire-grid floor. Stimuli could be projected onto the response key by Industrial Electronics Engineers in-line display cells equipped with GE 1815 miniature lamps and Kodak Wratten Filter No. 99, which provided chromatic light with peak wavelength transmission at 555 nm. The food hopper aperture was located directly below the pecking key. A houselight, mounted behind a 2.4-cm-wide strip of white Plexiglas located above the intelligence panel, provided ambient illumination to the conditioning chamber. Exhaust fans mounted behind the intelligence panel provided air circulation and low-level masking noise.

Procedures. Prior to the initiation of the experiment, the 36 pigeons were unsystematically divided into three groups of 12 pigeons each. On Day 1, all pigeons were trained to approach and eat from the food hopper. On Day 2, all pigeons received the first of 12 daily pretraining sessions of 60 autoshaping trials per session. Autoshaping trials were administered in a standard Pavlovian delay conditioning procedure, with a 6-sec green (555 nm) keylight CS and a 4-sec food hopper US. Trials were programmed according to a variable time (VT) 45-sec schedule. The mean number of keypeck responses per trial over the last 4 days of pretraining was utilized to create three groups of subjects matched for asymptotic levels of responding.

On the day following the final pretraining session, the groups received the first of five daily response elimination sessions. For all groups, trials were programmed according to the same VT 45-sec schedule used in pretraining. The CS-only group received 60 nonreinforced CS presentations per session and, at the end of each session, an amount of grain equivalent to 60 US presentations while in their home cages. The TRC group received similar training, except that 60 US presentations were programmed to occur randomly with respect to the CS during each session. The Backward group received 60 presentations of the CS and the US in each session, with CS onset occurring immediately following US termination. On the day following the final response-elimination session, all groups received the first of five daily reacquisition sessions, which were identical to the procedures used in the initial acquisition pretraining phase, except that the CS consisted of a vertical white line that bisected the otherwise dark response key.

Results

Evidence that the groups differed in the speed of elimination of responding was provided by the comparison of the number of trials required to attain a criterion of nonresponding for five consecutive trials. The mean numbers of trials to criterion were 35.25, 21.75, and 20.08 for Groups CS-only, Backward, and TRC, respectively. The data were entered into a simple one-way analysis of variance which revealed that the differences among the groups on the trials to criterion measure were statistically reliable [$F(2,33) = 14.53$, $p < .01$]. Furthermore, a Duncan's multiple range test revealed that the CS-only group required significantly more trials to reach criterion than both the TRC and Backward groups ($p < .05$), which did not reliably differ from one another.

These differences in mean numbers of trials to attain the response elimination criterion were consistent with the mean extinction functions for each group presented in Figure 1. As the figure reveals, response elimination was faster in the Backward and TRC

Figure 1. Mean number of trials with one or more responses as a function of five-trial blocks for Groups CS-only, TRC, and Backward.

Figure 2. Mean number of trials with one or more responses as a function of five-trial blocks for Groups CS-only, TRC, and Backward.

groups relative to the CS-only group. The data from the first response-elimination session were entered into a two-way analysis of variance, with treatment (CS-only vs. TRC vs. Backward) and blocks of five trials as factors. The analysis revealed a reliable main effect of treatment [$F(2,33) = 7.16$, $p < .01$] and a reliable Treatment by Trials interaction [$F(22,363) = 3.07$, $p < .01$]. A Fisher's l.s.d. test (Winer, 1971, pp. 199-200) revealed that the TRC and CS-only groups differed reliably on Blocks 4 and 5. A similar analysis of variance was performed on the Session 5 response-elimination data, which revealed no reliable main effect of treatment ($F < 1$), indicating that the three groups entered the reacquisition phase free of any confounding differences in levels of responding.

The reacquisition data were subject to the same types of analyses as were performed on the response-elimination data. Evidence that the groups differed in the speed of reacquisition of the keypeck response

was provided by a comparison of the number of trials required to attain a criterion of responding for five consecutive trials. The mean numbers of trials to criterion were 18.6, 28.4, and 54.2 for Groups CS-only, TRC, and Backward, respectively. The data were entered into a simple one-way analysis of variance, which revealed that the differences among the groups on this measure were statistically reliable [$F(2,33) = 6.17$, $p < .01$]. Furthermore, a Duncan's multiple range test revealed that all groups significantly differed from one another on the trials to criterion measure ($p < .05$).

These differences in mean numbers of trials to criterion were consistent with the mean reacquisition functions for each group, which are presented in Figure 2. As the figure reveals, the CS-only group reacquired the keypeck response the fastest, while the Backward group was the slowest. A two-way analysis of variance, with treatment and blocks of five trials as factors, was performed on the reacquisition data from Session 1. The analysis revealed a reliable main effect of treatment [$F(2,33) = 4.22$, $p < .05$] and a reliable Treatment by Trials interaction [$F(22,363) = 2.22$, $p < .01$]. A Fisher's l.s.d. test revealed that Groups CS-only and TRC differed reliably ($p < .05$) on Block 5, Groups CS-only and Backward differed on Blocks 3-12, and Groups TRC and Backward differed on Blocks 7-12. The reacquisition asymptotes for the three groups were comparable during the last 180 trials, which are not presented in Figure 2. This conclusion is supported by a mixed-design analysis of variance performed on the Day 5 data, which revealed no reliable effect of Treatment ($F < 1$).

Pearson's product-moment correlation coefficients were computed for the trials-to-criterion data from initial acquisition, response elimination, and reacquisition. For each subject within a group, the trials-to-criterion scores for initial acquisition were compared with those of both response elimination and reacquisition, and scores for response elimination were compared with those of reacquisition. For all three groups, none of the correlations approached significance, thus indicating that the speeds of both response elimination and reacquisition were not correlated with the speed of initial acquisition and also that the speed of reacquisition was not correlated with the speed of response elimination.

Discussion

The results of Experiment 1 indicate that the presence of the US during response elimination procedures has systematic effects upon both the elimination and reacquisition of autoshaping. More specifically, groups given extinction trials with the US present (TRC and Backward) ceased responding more rapidly than did the CS-only group. Furthermore, in a reacquisition test with a novel CS, the groups

given extinction trials with the US present were retarded in reacquiring the CR, relative to the CS-only group.

One might argue that the more rapid elimination of responding in the Backward group is attributable to the antagonistic influence of inhibitory strength accrued to the backward CS. The argument seems persuasive. There is considerable experimental evidence that backward conditioning produces associative inhibition as assessed in retardation (see Siegel & Domjan, 1971) and summation (see Moscovitch & LoLordo, 1968) test procedures. The retardation test of inhibition is predicated upon the assumption that inhibition may be assessed by the retardation of excitation. It seems reasonable to suggest that the accrual of inhibition during exposure to a suspected inhibitory preparation (i.e., backward conditioning) may be assessed by the dissipation of excitation (indexed by the elimination of the CR). That is, the more rapid elimination of responding in the Backward group may be a function of inhibition produced by that procedure. The supposition that the interaction between excitation and inhibition would be algebraically symmetrical is reasonable and would account for the Backward vs. CS-only difference; however, the TRC vs. CS-only effect cannot be explained by reference to differences in inhibition.

A more parsimonious interpretation relies upon the assumption that the context is conditioned when paired with the US during the response-elimination phase. During response elimination, both the TRC and Backward groups cease responding more slowly than does the CS-only group. The context-US pairings experienced by the TRC and Backward groups would presumably establish the context as an excitatory stimulus, whereas the nonreinforced context exposure experienced by the CS-only group would presumably diminish the excitatory strength of the context. Since the decrements in associative strength accrued to a CS are known to be related to the excitatory strength of the compound of cues within which the CS is embedded at the time of nonreinforcement (Wagner, 1969), the slower elimination of responding in the CS-only group may be attributable to the nonreinforced compounding of the green-key CS with the weakly excitatory context.

The reacquisition results indicated that the TRC and Backward groups were both retarded relative to the CS-only group, with the Backward group reacquiring reliably more slowly than the TRC group. These results may also be taken to reflect differences in the excitatory strength of the context at the end of the response-elimination phase. That is, the TRC and Backward groups experienced unsignaled US presentations during response elimination, which may engender context blocking during subsequent reacquisition. Moreover, the context-blocking analysis can presumably account for the reliably greater retarda-

tion observed in the Backward group. During response elimination, the TRC group received random US presentations which presumably condition the context; however, this context conditioning may be overshadowed by chance forward pairings of the CS and the US. Forward CS-US pairings are never experienced by the Backward group during response elimination; hence, the context is protected from such overshadowing.

The elimination and reacquisition of Pavlovian CRs have been noted, by a number of investigators, to be influenced by the presence or absence of the US during the response-elimination phase (see Ayres & DeCosta, 1971; Ayres, Mahoney, Proulx, & Benedict, 1976; Frey & Butler, 1977). Interestingly, these experiments do not involve testing for reacquisition with a novel CS; nevertheless, they show that reacquisition is retarded following response elimination procedures (e.g., TRC, backward conditioning, explicitly unpaired) that retain the US relative to CS-only extinction procedures. Their reacquisition effects may reflect the operation of context blocking, in which case the effects should transcend the introduction of a novel CS during testing for reacquisition.

The response-elimination results of the present experiment are consistent with those reported by Ayres et al. (1976), who found facilitation of response elimination by backward conditioning relative to a CS-only extinction procedure. However, other investigators (Ayres & DeCosta, 1971; Frey & Butler, 1977) have noted retardation of response elimination in treatments which retain the US, relative to CS only. Numerous methodological and procedural differences make it difficult to reconcile this empirical discrepancy or to specify the circumstances under which the presence of the US during response elimination will facilitate or retard the elimination of the response.

EXPERIMENT 2

The reacquisition results obtained in Experiment 1 indicated that the CS-only group reacquired keypecking more rapidly than either the TRC or Backward groups. These differences in reacquisition were interpreted as reflecting differences in the excitatory strength of the context at the end of the response-elimination phase of the experiment. That is, the TRC and Backward groups, which experienced unsignaled US presentations during response eliminations, were seen as being retarded in reacquiring the response due to the blocking influence of the context. Experiment 2 was designed to determine the effects of administering US-only training between the response elimination and reacquisition phases of the experiment. From a context-blocking analysis, such training would be expected to introduce retardation in the CS-only group and enhance retardation in the TRC group.

Method

Subjects. The subjects were 40 experimentally naive adult pigeons housed and maintained as in Experiment 1.

Apparatus. The apparatus was the same as in Experiment 1.

Procedures. Prior to the initiation of the experiment, the 40 pigeons were unsystematically divided into two groups of 20 each. On Day 1, all pigeons were trained to approach and eat from the hopper, with training consisting of 60 hopper presentations programmed according to a VT 45-sec schedule. On Day 2, all pigeons received the first of 12 daily autoshaping sessions identical to those of Experiment 1. As in Experiment 1, the mean number of keypeck responses per trial over the last 4 days of pretraining was utilized to create two groups of subjects matched for asymptotic levels of responding. The day following the final pretraining session, the groups received the first of five daily response-elimination sessions identical to those of Experiment 1, with one group receiving CS-only training and the other receiving the TRC procedure. The day following the final response-elimination session, half of the subjects in each group received the first of five daily sessions of 60 US presentations programmed according to the same VT 45-sec schedule used during initial acquisition. The other half of the subjects in each group were assigned to a "hold" condition and received the amount of grain equivalent to 60 US presentations daily while in their home cages. The day following the final US-only session, all subjects received the first of five reacquisition sessions identical to those of Experiment 1.¹

Results

The mean numbers of trials required to attain a criterion of nonresponding for five consecutive trials were 22.05 and 36.90 for the CS-only and TRC groups, respectively. A *t* test (two-tailed) for independent means indicated that the difference between the groups was not reliable [$t(38) = 1.84, p > .05$]. The mean extinction functions for each group are presented in Figure 3. The data from the first response-elimination session were entered into a two-way mixed-design analysis of variance, with treatment (CS-only vs. TRC) and blocks of five trials as factors. This analysis revealed no effects related to treatment ($F_s < 1$). A similar analysis of variance was performed on the Session 5 response-elimination data, which revealed no reliable main effect of treatment ($F < 1$), thus indicating that the groups entered the reacquisition phase free from any confounding differences in levels of responding.

The reacquisition data were subjected to the same types of analyses as were performed on the response-elimination data. The mean numbers of trials to attain a criterion of responding on five consecutive trials were 14.3, 25.8, 44.9, and 52.2 for Groups CS-only/Hold, CS-only/US-only, TRC/Hold, and TRC/US-only, respectively. The data were entered into a 2 by 2 factorial analysis of variance, with response-elimination treatment (CS-only vs. TRC) and posttreatment (Hold vs. US-only) as factors. The analysis revealed a reliable main effect of treatment [$F(1,36) = 7.62, p < .01$], but no main effect of posttreatment or Treatment by Posttreatment interaction ($F_s < 1$).

The reacquisition functions for each group are presented in Figure 4. As the figure reveals, the CS-only/Hold group reacquired the fastest, the TRC/US-only group reacquired the slowest, and the CS-only/US-

Figure 3. Mean number of trials with one or more responses as a function of five-trial blocks for Groups CS-only and TRC.

Figure 4. Mean number of trials with one or more responses as a function of five-trial blocks for Groups CS-only/Hold, CS-only/US-only, TRC/Hold, and TRC/US-only.

only and TRC/Hold groups reacquired at similar intermediate rates. A three-way, mixed-design analysis of variance, with treatment (CS-only vs. TRC), post-treatment (Hold vs. US-only), and blocks of five trials as factors, was performed on the reacquisition data from Session 1. The analysis revealed a reliable main effect of treatment [$F(1,36) = 6.97, p < .025$], a nonsignificant main effect of posttreatment [$F(1,36) = 2.89, .05 < p < .10$], and a reliable Posttreatment by Trials interaction [$F(11,396) = 1.88, p < .05$].

A Fisher's l.s.d. test revealed that Group CS-only/Hold had a reliably greater CR probability ($p < .05$) than Group CS-only/US-only (Block 1), Group TRC/Hold (Blocks 1-3), and Group TRC/US-only (Blocks 1-8). Group TRC/US-only, furthermore, was reliably retarded relative to Groups CS-only/US-only (Blocks 3-5) and TRC/Hold (Block 5).

Pearson's product-moment correlation coefficients were computed for the trials-to-criterion data from initial acquisition, response elimination, and reacquisition. For each subject within a group, the trials-to-

criterion scores for initial acquisition were compared with those of both response elimination and reacquisition and those of response elimination with those of reacquisition. For all three groups, none of the correlations approached significance, thus indicating that the speed of both response elimination and reacquisition was not correlated with the speed of initial acquisition and also that the speed of reacquisition was not correlated with the speed of response elimination.

Discussion

The response-elimination results of Experiment 2 fail to replicate the effects reported in Experiment 1. That is, in Experiment 1, the CS-only group extinguished faster than the TRC group. In the present experiment, no reliable response-elimination differences were noted; furthermore, the ordinal outcomes were the opposite of those noted in Experiment 1. Perhaps this discrepancy in results may, at least in part, be attributable to procedural considerations inherent in the TRC procedure. Chance CS-US pairings that occur during the TRC procedure may condition the CS and thereby interfere with response elimination. Similarly, early unpaired USs may condition the context and facilitate response elimination by blocking the conditioning of the CS on subsequent chance CS-US pairings. The number and relative location of CS-US pairings are crucial events which influence the effectiveness of the TRC procedure in eliminating the CR (cf. Ayres, Benedict, & Witcher, 1975). It is conceivable that uncontrolled and unmonitored differences in these aspects of the TRC procedures used in Experiments 1 and 2 contributed to the inconsistency of the response elimination data. It is interesting to note that the reacquisition effects noted in Experiments 1 and 2 are quite similar despite the discrepancy in the response elimination outcomes. This suggests that reacquisition and response elimination do not covary, an observation which is consistent with the results of correlational analyses of the within-treatment scores.

The reacquisition results of Experiment 2 replicate those of Experiment 1 in that the CS-only treatment produces faster reacquisition than does the TRC treatment. While the effect of the Hold vs. US-only posttreatment manipulation is also consistent with the context-blocking hypothesis, the effect is considerably less robust and the support for the hypothesis is less impressive. The posttreatment manipulation produces differences in the CS-only condition only in Block 1 and in the TRC condition only in Block 5. The more limited retarding influence of the posttreatment manipulation as compared with the treatment manipulation is, perhaps, attributable to the context-US arrangements provided by those procedures. The treatment manipulation (TRC vs. CS-only) provides a comparison of the effects of context

conditioning with the effects of context extinction, whereas the posttreatment manipulation (US-only vs. Hold) compares context conditioning with the absence of context conditioning. Since extinction of the context would be expected to reduce the blocking properties of the context (Tomie, 1976b), the more impressive effect of the treatment manipulation is not completely unexpected.

The pattern of results tends to indicate that the retarding effect of the US-only posttreatment manipulation summates with the retarding effect of the TRC treatment. The CS-only/US-only group is retarded early in acquisition (Block 1) relative to the CS-only/Hold group, whereas the TRC/US-only group is retarded later in acquisition (Block 5) relative to the TRC/Hold group. That is, retardation is introduced by either the TRC or the US-only factor, and the magnitude of the retardation appears to be directly related to the amount of experience with unpredictable presentations of food.

Although the data are generally consistent with the context-blocking hypothesis, there are several aspects which are not supportive. As mentioned earlier, the context-blocking hypothesis predicts more rapid response elimination in the TRC group, an effect not observed in Experiment 2. Also troublesome is the ordinal relationship of the groups at the reacquisition asymptote. Although there was no statistically reliable groups effect on Day 5 of reacquisition, the CS-only/Hold group, which reacquired the fastest and experienced no unpredictable feedings, had the lowest asymptotic response probability. This is attributable to a breakdown in automaintenance by three subjects in this group, whereas comparable breakdowns in automaintenance were not observed in any subjects in the other groups of either experiment. The contextual influence should be equally minimal for all groups at reacquisition asymptote; therefore, the breakdown in automaintenance by subjects only in the CS-only/Hold group is inconsistent with the context-blocking hypothesis.

GENERAL DISCUSSION

The data indicated that reacquisition to a novel CS is systematically influenced by the nature of the experimental procedures administered prior to the reacquisition test. The reacquisition of autoshaping is retarded when keypecking is eliminated by the backward conditioning procedure (Experiment 1) or the TRC procedure (Experiments 1 and 2) relative to when keypecking is eliminated by the CS-only extinction procedure. The backward and TRC procedures share in common the administration of unpredictable US presentations. The centrality of this factor is reinforced in Experiment 2, in which it was shown that the US-only posttreatment procedure introduces and

enhances retardation in the CS-only and TRC groups, respectively. The effectiveness of the posttreatment manipulations also indicates that the procedures need not be present at the time of response elimination itself, in order to influence subsequent reacquisition.

The reacquisition data reported here are consistent with alternative CR reacquisition effects in the Pavlovian literature (see Ayres & DeCosta, 1971; Ayres et al., 1976; Frey & Butler, 1977) and extend the pattern of results to reacquisition testing with a novel CS. These results also suggest that previously documented reacquisition effects may be attributable to context-blocking considerations, since the reacquisition effect apparently does not depend upon the use of the CS used during the initial acquisition and response-elimination phases of the experiment.

The data are consistent with a context-blocking analysis; however, the evaluation of the data with respect to alternative theoretical accounts is appropriate. It is possible to view the retarded reacquisition of autoshaping as a general transfer-of-training effect that is a by-product of the associative impairment engendered by the TRC training wherein the US is unpredictable. Such interpretations have been applied to retardation effects in initial acquisition in autoshaping (cf. Engberg et al., 1972; Hall & Honig, 1974; Mackintosh, 1973). Their application to these reacquisition effects, however, seems less appropriate, since all subjects have a common history of previous autoshaping (during initial acquisition), which should provide all subjects with common cognitions (i.e., key illumination predicts food) as well as "immunization" against the deleterious effects of cognitive associative interference.

An alternative interpretation of retardation in autoshaping suggests that unpredictable US presentations establish competing behaviors which are superstitiously reinforced by instrumental acquisition processes (Gamzu, Williams, & Schwartz, 1973). These behaviors are, ostensibly, incompatible with the autoshaping response and thereby interfere with the acquisition of keypecking.

Such an interpretation is opposed by several lines of evidence. First, the adjunctive behavior of the food-deprived pigeon in the conditioning chamber is not incompatible with the topography of the autoshaping CR (Staddon & Simmelhag, 1971). On the contrary, the superstitious behaviors would actually tend to bring the pigeon into the vicinity of the key and produce orientation in the direction of that stimulus. Secondly, it is not clear that instrumentally maintained behaviors necessarily interfere with the acquisition of autoshaping. LoLordo, McMillan, and Riley (1974) have reported that pigeons would readily autoshape while concomitantly making a well-learned treadle-press response; furthermore, Engberg et al. (1972) found that instrumental reinforcement of a

treadle-press response facilitated autoshaping relative to a group of experimentally naive controls. The data reported here are particularly difficult to accommodate within a competing-response framework. To the degree that superstitious acquisition is a factor, one would expect that, during initial acquisition, behaviors compatible with keypecking would be temporally contiguous with food and hence instrumentally strengthened. Responses compatible with keypecking would therefore be most likely to be maintained during the response-elimination phase in the backward and TRC groups. Such behaviors should serve to facilitate, rather than retard, the reacquisition of keypecking.

In summary, it appears that the reacquisition, as well as the acquisition, of autoshaping is retarded by the administration of pretraining involving unpredictable US presentations. These effects are directly predicted by the context-blocking analysis. Additional experimental analysis involving context manipulations would allow for more rigorous evaluation of the validity of the conjecture.

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NOTE

1. One subject was discarded from the experiment and replaced. The replacement subject was one of two additional CS-only/Hold subjects designated as backups and was selected because the discarded and the replacement subjects were run in the same box. The two backup subjects were run at the time the experiment was performed. The discarded subject (Subject 8, Group CS-only/Hold) failed to meet the reacquisition criterion until Trial 332, whereas the next highest score for subjects in that group was 37. The subject was observed to be making pecking motions at the key which failed to close the microswitch contacts in the key. The trials to criterion score of this subject was over twice the value of the next highest score in the two experiments combined (Subject 6, Group TRC/Hold yielded a trials to criterion score of 155) and was determined to be an outlier (reliably deviant from the population of subjects utilized in Experiment 2) (Li, 1964). The outlier test consists of the derivation of the ratio of the sums of squares with and without the outlier. The derived ratio is .36, which, for a sample size of 40, is reliable (Table 12, p. 616) at the 1% significance level.

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