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Stimulus generalization decrement in latent inhibition to a compound following exposure to the elements or the compound

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In two experiments using the taste-aversion paradigm, we attempted to replicate a result reported by Holland and Forbes (1980), in which exposure to the elements of a compound produced more interference with future conditioning (latent inhibition) to the compound than did exposure to the compound itself. In our first experiment, a compound of HCl and sucrose was used and the amount of fluid consumed during exposure and the first conditioning trial was controlled. Rather than finding enhanced interference produced by exposure to the elements, we found reduced interference relative to exposure to the compound. In Experiment 2, a compound of NaCl and sucrose was used and a method similar to that used by Holland and Forbes was employed. We replicated the result of our Experiment 1. We interpret these results as posing problems for some associative accounts of latent inhibition but as being easily explained as an instance of stimulus generalization decrement.

In a latent inhibition experiment, exposure to a conditioned stimulus (CS) prior to conditioning reliably retards future classical conditioning (e.g., see Lubow, 1973). Certain attempts to analyze the nature of this phenomenon have made use of an experimental procedure that may be called the "distractor" preparation (see Kaye, Swietalski, & Mackintosh, 1988). In a distractor experiment, the target stimulus is accompanied during preexposure by some other stimulus, the distractor. The two stimuli may be presented as a simultaneous compound, or the distractor can precede, overlap, or follow the target. Conditioning is then conducted with the target presented on its own as the CS. Although the effect is by no means universal (see, e.g., Baker & Mercier, 1982a, Hall & Honey, 1989b; Mercier & Baker, 1985; Rudy, Krauter, & Gaffuri, 1976), some experiments have demonstrated that the presence of a distractor during preexposure can reduce the magnitude of latent inhibition (e.g., see Best, Gemberling, & Johnson, 1979; Honey & Hall, 1988; Lubow, Schnur, & Rifkin, 1976; Mackintosh, 1973; Matzel, Schachtman, & Miller, 1988).

There are two general classes of explanation for distractor effects in latent inhibition; we shall call the first perceptual and the second associative (see Honey & Hall, 1989). The perceptual explanation attributes the distractor effect (when it occurs) to generalization decrement (see Baker & Baker, 1985; Kaye et al., 1988): if the event used as the CS is different from that presented during preexposure, latent inhibition will be attenuated (Siegel, 1969). Such generalization decrement might occur when the percept of the target CS is influenced by the presence of the distractor during preexposure, causing it to be perceived as being physically different from the percept of the CS when it is presented alone. The preexposed compound might be perceived as a perceptual whole or as a configuration rather than as two distinct elements (Rescorla, 1973), and thus the CS would be perceived as a different event from that presented during preexposure. Alternatively, the subjects might analyze the compound into two separate elements but the presence of the distractor might interact with the target at the sensory or perceptual level (Hull, 1943), making it discriminably different from the stimulus used as the CS during conditioning. In either case, exposure to the compound would result in less latent inhibition than would exposure to the target alone.

Associative explanations can be derived from the theories of latent inhibition proposed by Lubow, Weiner, and Schnur (1981) and by Wagner (1976, 1981). The first of these theories proposes that the attentional learning that occurs during preexposure is governed by the same laws that govern classical conditioning. Accordingly, the presence of a distractor will result in overshadowing of the conditioning of inattention to the target. Wagner's (1976, 1978, 1981) theory attributes latent inhibition to

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the formation of an association between the experimental context and the target stimulus. This learning too will be subject to overshadowing. The presence of a distractor restricts the ability of the target to form an association with the context and, therefore, there is an attenuation of latent inhibition.

Honey and Hall (1988, 1989; Hall & Honey, 1989b) have argued that the perceptual explanation is preferable to an associative account because the former is better able to explain why distractor effects do not always appear. According to the perceptual explanation, distractor effects should be found only when the preexposed stimuli are events that are likely to form a configural cue or are likely to interact at the sensory/perceptual level. Honey and Hall went on to provide evidence that the distractor effect is not found when the two stimuli compounded during preexposure are very different (e.g., a tone and a diffuse light), but is readily observed when the stimuli come from the same modality (e.g., a tone and a clicker, Honey & Hall, 1989; a mixture of two flavors, one acidic and one sweet, Honey & Hall, 1988).

There is evidence to support an associative account, however, from an experiment by Holland and Forbes (1980), which used a flavor-aversion procedure. In that study, conditioning occurred with a compound flavor as the CS and preexposure was given either to that compound or to the elements of the compound presented separately. It was found that preexposure to the elements produced latent inhibition to the compound and did so more effectively than preexposure to the compound itself. We have already said that associative theories assume that elements presented in compound during preexposure will compete with one another, attenuating the extent to which either element can acquire latent inhibition. Elements exposed individually, however, undergo no such competition; each element acquires a full measure of latent inhibition and, thus, when the two elements are paired and conditioned in compound, there is more interference with conditioning than if they had been preexposed in compound. The parallel may be noted with a phenomenon in conditioning that has been referred to as "overexpectancy" (Kamin & Gaioni, 1974; Kremer, 1978; Wagner, 1971; Wagner & Rescorla, 1972), in which separate reinforcement of elements can endow a compound with more associative strength than can equivalent reinforcement of the compound itself.

An implication of the associative explanation of the effects of preexposure to a compound is that the procedures that have been effective in revealing a distractor effect should also be capable of generating the effect reported by Holland and Forbes (1980) when exposure occurs to the elements and conditioning occurs with the compound as the CS. Both the distractor effect and the finding reported by Holland and Forbes (1980) are held to depend on competition between the two elements when they are exposed as a compound. The distractor effect results when competition between the elements reduces the amount of latent inhibition accruing to the individual elements when they are later conditioned separately, whereas in the Holland and Forbes experiment, competition between elements limits the total latent inhibition accruing to the compound in the control group receiving compound exposure. Thus, separate preexposure to the two flavors used by Honey and Hall (1988) should produce more latent inhibition to the compound than should exposure to the compound itself, provided that the distractor effect they demonstrated is correctly interpreted in associative terms. In contrast, the perceptual account of Honey and Hall's distractor effect makes the opposite prediction: If the distractor effect occurs because an element presented in compound is not perceived as being the same as that element when presented alone, then preexposure to the elements presented separately should not greatly influence future conditioning to the compound. Exposure to the elements should produce less interference with future conditioning to the compound than should exposure to the compound itself. In Experiment 1, we tested these divergent predictions.

EXPERIMENT 1

In this experiment, we made use of the same stimuli and general training procedures as were used by Honey and Hall (1988), but in this case, we examined the effects of preexposure on conditioning to the compound. All subjects received conditioning with a compound stimulus consisting of a mixture of a solution of dilute hydrochloric acid (HCl) and a sucrose solution. For control subjects, these flavors were novel. Subjects in an elements group received preexposure to HCl and sucrose presented separately; those in a compound group received preexposure to the compound. The associative account of the distractor effect reported by Honey and Hall predicts that preexposure to the elements should be especially effective in producing latent inhibition; the perceptual account predicts that this procedure should be relatively ineffective.

Method

Subjects. The subjects were 30 Wistar rats that had previously served in a conditioned suppression experiment. During that experiment, the animals had been food-deprived and had leverpressed for food. They had been exposed to clickers and several mild electric shocks. When the animals were assigned to groups for the present experiment, they were counterbalanced so that all previous treatments were, as much as possible, equally represented in each of the present groups.

Apparatus and Solutions. The animals were housed in standard stainless steel wire hanging cages, 18 cm wide, 24 cm deep, and 18 cm high, and had constant access to food. When available water was delivered through a standard stainless steel drinking tube inserted into a 50-ml plastic centrifuge tube. The four drinking solutions were 0.3 M sucrose, 0.01 M HCl, a solution containing 0.3 M sucrose and 0.01 M HCl, and tap water. The solvent for all solu-

tions was tap water. On any day that the animals were exposed to a solution, they received 15 ml of the solution in the standard centrifuge tubes. The unconditioned stimulus was an intraperitoneal injection of isotonic (0.15 M) lithium chloride (LiCl; 10 ml/kg body mass).

Procedure. Over a period of 5 days, the animals were gradually adapted to a water-deprivation schedule under which they received access to water in standard drinking bottles for 30 min per day. For the next 2 days, all animals were given access to 15 ml of tap water in the drinking tubes. The tubes were removed after 30 min had elapsed. All animals drank all of the water within this period by Day 2. Following this phase came the exposure phase of the experiment, which lasted for 8 days. On each of these days, all animals received access to 15 ml of the appropriate solutions at 1200 h.

The animals were divided into three groups for the exposure phase. The compound exposure group received the HCl-sucrose compound solution on Days 1, 3, 5, and 7 and water on Days 2, 4, 6, and 8. The element group received exposure to the HCl and sucrose solutions on alternating days. Half of the animals received the sucrose solution first and the other half received the HCl solution first. The control group received tap water on each of the 8 days. On each day, the tubes were removed after 30 min unless the animal had not consumed the 15 ml of solution, in which case the tubes were left on the cages until all of the solution had been consumed. This was necessary only on Day 1. On subsequent days, all of the animals drank the 15 ml of solution within 30 min.

The next day was the first day of the test phase. During this phase, all animals received two pairings of the compound and LiCl, two compound extinction tests, and a drinking test involving the individual elements. These conditioning and test days were given on alternate days. The days in between the conditioning and test days were recovery days, on which all animals received access to water for 30 min. On Conditioning Day 1, all animals received a 30-min exposure to 15 ml of the compound. After the tubes were removed, the animals received an injection of LiCl. The delay between removing the tubes and the injection varied from 1 to 30 min. The length of the delay was counterbalanced within the groups. The next day was a recovery day, on which all animals received free access to water for 30 min. A second conditioning day followed, in which all animals received a 30-min access to the compound followed by another LiCl injection. Because the animals in the various groups drank different amounts, all animals received a 30-min access to water at 1730 h on this day. Following Conditioning Day 2 was another recovery day, on which all animals received access to water for 30 min. On Extinction Test Day 1, all animals received a 30-min access to the compound solution at 1200 h and, at 1730 h, they received a 30-min access to water. Another recovery day followed, on which the animals received a 30-min access to water at 1200 h. The next day was another compound test day, followed by a recovery day. Finally, the animals received an element test day, on which half of the animals received a 30-min access to sucrose and half received a 30-min access to HCl at 1200 h.

Data and Statistical Analyses. The amount of solution drunk by each animal was determined by weighing the centrifuge tubes before the beginning and after the end of each session. These scores were converted to milliliters drunk, assuming that the specific density of all solutions was 1.

Statistical analyses were done using split-plot analyses of variance. If the interactions of these analyses were reliable, we carried out individual between-groups, one-way analyses on each trial (simple-effects analyses). These analyses used a between-subjects error term from that trial. Post hoc tests used orthogonal sets of comparisons and contrasts using Scheffé's (1953) method. We used a 5% rejection level throughout the study.

Results

Except for the first exposure day, when 1 animal in the compound group received extra time to drink the 15 ml of solution, all animals drank all 15 ml of solution within 30 min during the preexposure phase and on Conditioning Day 1. Figure 1 shows the amount of the compound consumed during Conditioning Day 2 and the 2 extinction test days. As the figure shows, the results directly contradict those reported by Holland and Forbes (1980). The compound group conditioned more slowly and to a lower ultimate level than the control group, and the animals exposed to the elements showed an intermediate level of conditioning. The statistical analyses supported this impression. Both main effects and the interaction of the split-plot analysis, which included Conditioning Day 2 and the 2 extinction days, were reliable [$F(2,27) = 19.74$, $F(2,54) = 92.76$, and $F(4,54) = 5.46$]. The simple-effects analyses for each day were all reliable [minimum $F(2,27) = 11.11$]. On Conditioning Day 2, the control group drank reliably less than the compound group [$F(2,27) = 11.10$]. On Extinction Test Day 1, the element and control groups drank less than the compound group [$F(2,27) = 30.17$]. On Extinction Test Day 2, the compound and element groups drank more than the control group [$F(2,27) = 10.21$].

There was very little suppression of drinking to either the sucrose or the HCl solutions on the element test. The 5 control-group animals tested with the sucrose solution consumed a mean of 12.23 ml, and all other groups had means greater than 14 ml. A factorial analysis of variance with groups and solutions as factors indicated that

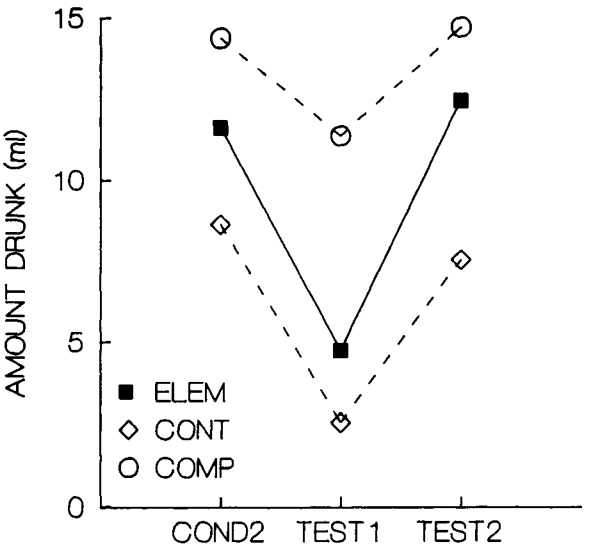

Figure 1. Mean amount of the HCl–sucrose compound consumed on Conditioning Day 2 (COND2) and the 2 extinction days (TEST1 and TEST2) in Experiment 1 (on the Conditioning Day 1, all animals drank all 15 ml of the solutions). ELEM-animals exposed separately to the HCl and sucrose solutions, COMP-animals exposed to the compound of the two solutions, CONT-animals exposed to water.

the groups did not differ on this test [$F(2,24) = 1.67$ for groups, other Fs < 1].

Discussion

The results of this experiment are clearcut. Preexposure to the elements of a compound CS produced less latent inhibition than did preexposure to the compound itself. This result, obtained with the stimuli and procedures employed by Honey and Hall (1988), would be expected given a perceptual interpretation of the effects of preexposure to a compound consisting of a mixture of two flavors. If the elements presented separately are not identified as being the same as the elements mixed in a compound, then latent inhibition from preexposure to the elements cannot be expected to transfer to the compound. The results are not predicted, however, by the associative analogy to the overexpectancy experiments (Wagner, 1981; Wagner & Rescorla, 1972). According to that theory, preexposure to stimuli as a compound should restrict the growth of latent inhibition to each element and should thus interfere less with subsequent compound conditioning than should preexposure to the separate elements. Recall that this was the finding reported by Holland and Forbes (1980) in an experiment that was formally very similar to ours. If we are to reject the associative interpretation of these phenomena, as Experiment 1 suggests we should, it will be necessary to account for the effect reported by Holland and Forbes.

EXPERIMENT 2

As a first step, it seemed sensible to attempt to replicate the effect found by Holland and Forbes (1980, Experiment 2). Although formally similar to our Experiment 1, their study differed in many details, differences that must be presumed to be responsible for the discrepant results: different flavors were used (salt, NaCl, rather than HCl), the amount of fluid offered was not restricted to a fixed amount as it was in our Experiment 1, more exposure trials were given, and so on. Accordingly, in the present experiment, we attempted an exact replication of the critical groups of the Holland and Forbes study. In addition, we extended their procedure to allow a more detailed analysis of the behavior of the animals during the preexposure phase.

There were four main groups of subjects, all of which ultimately received conditioning with a NaCl-sucrose compound. All subjects received 14 exposures to various solutions over the 7 days that preceded conditioning. The control group (W14) was exposed only to tap water during this period. The element group (E14) received seven exposures to NaCl and seven exposures to a sucrose solution. Two compound groups were included, following the procedure of Holland and Forbes (1980), who split their compound group into two, one subgroup receiving the same total number of exposures as the element group (and thus twice as much experience with each individual element) and one subgroup receiving only half the number of exposures (and thus the same amount of experience with each of the elements). Thus, our Group C14 received 14 exposures to the compound and Group C7 received seven compound exposures.

Method

Subjects. The subjects were 32 Wistar rats obtained from Quebec breeding farms. The rats had previously been used in a conditioned suppression experiment that had involved leverpressing for food. They had received clicker and light stimuli and a number of shocks in operant chambers. The animals were divided into four groups for this experiment, counterbalanced for membership in the four treatments of the earlier experiment. Twelve days elapsed between the end of the previous experiment and the beginning of the water-deprivation phase of the present one. During this time, the animals had free access to Purina Lab Chow and water, and were handled and weighed daily.

Apparatus and Solutions. The same cages and centrifuge tubes described for Experiment 1 were used in the present experiment. Five drinking solutions were used in this experiment: a 0.1-M sucrose solution, 0.2 M NaCl, 0.005 M HCl, a compound solution consisting of 0.1 M sucrose and 0.2 M NaCl, and tap water. The solvent for the solutions was tap water. Illness was induced by a 5-ml/kg body weight intraperitoneal injection of 0.3 M LiCl dissolved in tap water.

Procedure. Over 7 days, the subjects were adapted to a water-deprivation schedule under which they received two 10-min periods of access to water each day, one at 0900 h (mornings) and the other at 1630 h (afternoons). The experiment began this water-deprivation treatment.

On each day of the experiment, the animals continued to receive two 10-min drinking periods, one in the morning and the other in the afternoon. The first 7 days were the exposure phase of the experiment. The animals were divided into four groups. Two groups of 8 rats were exposed to the NaCl-sucrose compound. One of these groups (Group C14) received the compound solution in the morning and in the afternoon for the entire 7 days (14 exposures). The other group (Group C7) received water for the first seven exposure trials and received the compound for the last seven exposure trials. Each of the animals in the element preexposure group (Group E14) received one of two irregular sequences consisting of seven exposures to the sucrose solution and seven exposures to the saline solution (the sequences were counterbalanced for order of presentation of the two fluids). Finally, the control group (Group W14) received water throughout the exposure phase.

After the exposure phase there followed 2 water-recovery days, in which all animals received water in the mornings and in the afternoons. The test phase followed, which consisted of 2 compound conditioning days, 4 compound extinction days, and, finally, an element test.

During the conditioning and extinction days, the animals in all groups received a 10-min drinking period each morning, during which they received the NaCl-sucrose compound. On the 2 conditioning days, the animals received an injection of LiCl following the session. In the afternoon of each day, the animals received the acid solution. They received this novel solution because Holland and Forbes (1980) used it to control for exposure in their sensitization controls, which had been included to control for the effects of LiCl injections. These control groups received conditioning to HCl in the afternoons and nonreinforced exposure to the compounds in the mornings. We did not include these controls because Holland and Forbes found no evidence of sensitization. Following the compound extinction days, the animals received an element test, which consisted of one presentation of the saline solution and one presentation of the sucrose solution on the mornings of the final 2 days of the experiment. They received HCl on the afternoon of

the penultimate day. The order of these stimuli was counterbalanced within each group.

Results

The amount of solution drunk during selected periods of the exposure phase and during the mornings of the test phase of the experiment are shown in Figure 2. The data shown for the exposure phase were chosen to represent comparable periods of exposure of the groups to the various solutions. These data include the first seven exposures to the various solutions for all of the groups. They include, therefore, the first seven exposures of Group C14 to the compound, all seven exposures of Group C7 to the compound, all seven exposures of Group E14 to the sucrose and to the saline, and the first seven exposures of Group W14 to water. It is clear from this graph that all of the solutions that included sucrose supported a higher level of drinking than did water, and that, if anything, the saline solution supported less drinking than did water. The statistical analyses support the former contention but do not allow us to assert the latter. We carried out two identical split-plot analyses of variance on the data; one included the sucrose scores for Group E14 and the other included the saline scores. For each analysis, both of the main effects (trials and treatments) were reliable, as was the interaction [minimum $F(3,28) = 9.17$, $F(6,168) = 14.42$, and $F(18,168) = 3.18$]. No contrasts were reliable on the first exposure day, but throughout the remainder of the exposure phase, the mean consumption of Group W14 was reliably less than the combined amount of the compound consumed by Groups C14 and C7 and the amount of sucrose consumed by Group E14 [minimum $F(3,28) = 4.41$]. The sucrose consumption of Group E14 was reliably higher than the compound consumption of the two compound groups on only the third exposure day [$F(3,28) = 4.07$; all nonreliable Fs$(3,28) < 1$]. The amount of drinking supported by the saline solution was always less than the amount of water consumed by Group W14, but never reliably so [maximum nonsignificant $F(3,28) = 2.59$]. In addition to the split-plot analyses, we directly compared the amount of drinking supported by the saline and sucrose solutions in Group E14 and found a reliable main effect of treatment [$F(1,7) = 82.24$] and a reliable interaction [$F(6,42) = 4.14$]. Post hoc comparisons indicated that these scores differed on each day [minimum $F(1,7) = 10.11$], except the first day [$F(1,7) = 3.50$].

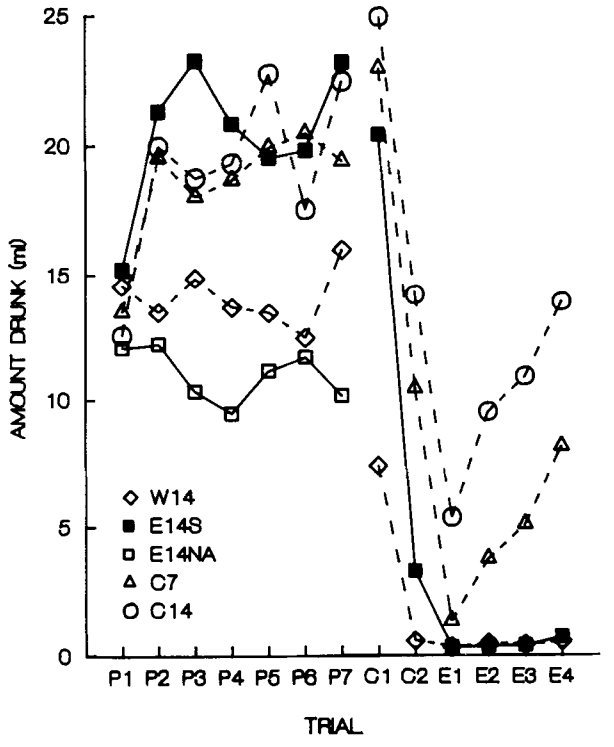

Figure 2. Mean amount of the various solutions consumed in the exposure and test phases of Experiment 2. During the preexposure days (P1–P7), the amount shown is the amount of the compound for the two compound exposure groups (C7 and C14), the amount of sucrose (E14S) and NaCl (E14NA) for the element exposure groups, and the first seven water exposures for the control group (W14). On the conditioning and extinction days (C1–E4), the amount shown is the amount of NaCl–sucrose compound consumed in the mornings by each group.

The data of main interest involve the acquisition and extinction of the aversion to the compound solution in the mornings of the test phase. As Figure 2 shows, these data are quite straightforward. Group W14 showed some evidence of an initial disruption of drinking during the first conditioning session and then suppressed drinking for the remainder of the test. The data from the element and compound exposure groups are more crucial. It is clear that Group E14 suppressed drinking quite rapidly and then showed little evidence of recovery for the remainder of the experiment. On the other hand, the animals that had received exposure to either 7 or 14 compound presentations suppressed drinking more slowly than did Group E14 and showed considerable extinction of their aversions to the compound on the 4 extinction days. It also appears that Group C14 conditioned more slowly than Group C7. The statistical analyses support these contentions. Both main effects and the interaction of the split-plot analysis comparing these groups across the 6 mornings of the test were reliable [$F(3,28) = 25.44$, $F(5,140) = 143.63$, and $F(15,140) = 8.48$]. The subsequent one-way analyses of variance comparing the groups on each trial were all significant [minimum $F(3,28) = 4.80$]. On the first test day, Group W14 drank less than the combined mean of the other three groups [$F(3,28) = 25.98$], and the other three groups did not differ from one another [maximum $F(3,28) = 1.49$ between Groups E14 and C14]. Because the means were fairly evenly distributed throughout the remainder of the test, and because the critical differences were between Groups C7 and E14, we carried out a series of direct comparisons between them rather than the more powerful orthogonal sets. These two groups differed reliably on Conditioning Day 2 [$F(3,28) = 4.92$] and on the final extinction day [$F(3,28) = 3.29$]. Group C14 drank more than Group E14 on all but Conditioning

Day 1 [minimum reliable $F(3,28) = 3.56$]. Group C14 drank reliably more than Group C7 on Extinction Days 2 and 3 [$F(3,28) = 3.84$, and $F(3,28) = 3.07$].

The results of the element test are shown in Figure 3. It is clear that the groups maintained their ordering on both stimuli, and that they drank more sucrose than saline. It also appears that the difference between saline and sucrose was largest in Group E14. The statistical analyses support only the first two impressions, however. The main effects for treatment and solution were both significant, but the interaction was not [$F(3,28) = 20.95$, $F(1,28) = 27.04$, and $F(3,28) = 2.46$]. Post hoc tests within the main effect for treatments indicated that neither Groups C14 and C7 [$F(3,28) = 0.98$] nor Groups E14 and W14 [$F(3,28) = 1.04$] differed in their drinking, but Groups C14 and C7 drank more than Groups E14 and W14 [$F(3,28) = 18.92$].

Discussion

This experiment was designed to replicate Holland and Forbes's (1980) finding that exposure to the elements of a compound produces more latent inhibition to the compound than does exposure to the compound itself. In this experiment, as in Experiment 1, which used rather different parameters, our results not only do not replicate theirs but are in the opposite direction. Exposure to the elements produced less, rather than more, interference with conditioning regardless of whether the animals in the compound exposure group (Group C14) had the same number of total exposures as the animals in the element exposure group or whether they had the same amount of exposure to each element (Group C7).

The present experiment, although it is very close to being an exact replication of Holland and Forbes's (1980) procedures, suffers from at least two shortcomings. First, our animals obviously preferred the sucrose solution to the saline solution, as did their animals. An ideal test would have used stimuli that the animals found equally palatable, or would at least have controlled the amount of drinking as we did in Experiment 1. This might be important, because the amount of solution consumed has been shown to influence the strength of flavor aversions (e.g., see Bond & Di Giusto, 1975). In addition, it has been shown that the amount of solution that is consumed on a test is a function of the amount of that solution previously consumed (e.g., see Domjan, 1976). Second, there was evidence of neophobia to the compound in the control group (Group W14). With the introduction of the compound, the animals in that group drank even less than they drank water during baseline. Thus, compared to the other groups, which had developed a preference for the solutions containing sucrose during exposure, the animals in Group W14 showed an initial disruption during conditioning. It is thus possible to argue that the rapid conditioning in this control group was due not to differences in the associability of the flavors, but simply to an enhancement of this neophobia through sensitization.

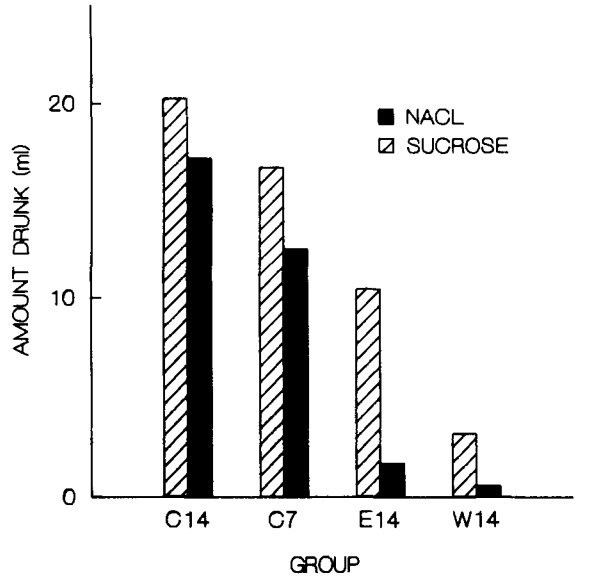

Figure 3. Mean amount of the individual elements consumed on the 2 element test days by the groups in Experiment 2.

The critical comparison, however, does not include this group, but involves the element group and the compound groups. On the first day of conditioning, all three groups showed a similar high level of drinking, yet Group E14 suppressed responding more rapidly, and maintained that suppression much longer, than either compound group. It is also interesting that there was relatively little disruption of drinking in Group E14 caused by the "addition" of saline to the sucrose on the first day of the test. This lack of a dishabituation-like process is quite relevant to, and inconsistent with, theories (e.g., Wagner, 1976, 1981) that equate dishabituation with the changes in associability that are found in latent inhibition.

Holland and Forbes's (1980) results from the exposure phase are not available for comparison. The main discrepancy between our data and their reported data is the initial disruption of drinking found in Group W14 on Conditioning Day 1. In all of their groups, including their water-only groups, the level of drinking was comparable to the level of our element and compound exposure groups (greater than 20 ml). This level is above the level supported by water (less than 15 ml) and the initial level of drinking of both the compound and the sucrose solutions in our groups during preexposure. The initial low level of drinking of the compound in Group W14 on Test Day 1 is consistent with our other groups' tendency to drink less of the compound or sucrose on their initial exposure to them than later (perhaps this in an example of the habituation of neophobia to the novel solutions). But the absolute level of drinking in Group W14 (8 ml) was even lower than the initial drinking of the solutions in these other groups. Holland and Forbes's animals, however, showed no such initial disruption. We do not know whether this is typical of all their groups or whether it is peculiar to their water group, because their baseline data were not reported. They used a different strain of

rats (Sprague-Dawley vs. Wistar), which were raised in their laboratory and had been handled extensively since weaning (Holland, personal communication), whereas our rats were obtained from a commercial supplier. Holland (personal communication) has suggested that early intensive handling might reduce neophobia. It must be mentioned that our rats had been weighed and handled daily for more than 2 months before they participated in the experiment.

One difficulty for a naive generalization decrement analysis of our results is that although the differences in conditioning are consistent with the analysis, other aspects of our data do not seem to agree so well. For instance, the animals in Group E14 drank as much of the compound solution on the first conditioning trial as they had drunk of the sucrose solution on the last exposure trial. If they were treating the compound as a radically different stimulus from the individual elements, we might expect them to drink less of the compound on the first exposure trial; rather than perfect transfer of habituation, we might expect some dishabituation. There is little to say about this except to note that in other preparations, habituation has proved to be very insensitive to associative manipulations that have modified the strength of latent inhibition. Our results do not stand in isolation (cf. Hall & Honey, 1989b).

GENERAL DISCUSSION

Our results show quite clearly that, in flavor-aversion learning with a compound flavor as the CS, preexposure to the elements of a compound produces less latent inhibition than does preexposure to the compound itself. This effect was found not only with the experimental procedures employed by Honey and Hall (1988), but also with those used by Holland and Forbes (1980) in an experiment that generated quite the opposite result. There seems little point in speculating further about the discrepancy between our Experiment 2 and that of Holland and Forbes. We can say, however, that we conducted a replication of our Experiment 2 and came up with essentially the same pattern of results as were reported here. We must conclude, therefore, that the effect reported by Holland and Forbes appears to be obtainable only under a very restricted set of conditions, and that in our experience, preexposure to the elements of a compound is reliably less effective in producing latent inhibition than is equivalent preexposure to the compound itself.

The theoretical implication of this conclusion is that it undermines some of the attempts that have been made to provide an associative account of latent inhibition. These accounts (e.g., Lubow et al., 1981; Wagner, 1976, 1978, 1981) seem to be supported by the observation that preexposure to a compound will (sometimes) produces less latent inhibition than will preexposure to an element when conditioning occurs to that element. But, as Honey and Hall (1988, 1989; Hall & Honey, 1989a) have pointed out, this distractor effect, when it occurs, can be plausibly interpreted as an example of generalization decrement. The results reported here, which are exactly what is predicted by the notion that there will be generalization decrement when an element previously experienced on its own occurs in compound with some other stimulus, support the perceptual account of distractor effects. There is no need, on the basis of these results, to suppose that the associative mechanisms proposed by Lubow et al. (1981) and by Wagner (1976, 1978, 1981) were operating in these experiments.

Pearce (1987) has recently proposed a model of conditioning that depends on stimulus generalization decrement, and although he has not formally extended it to latent inhibition, it may be relevant to do so here. According to this model, when two elements (A and B) are separately trained and then presented together (AB), the amount of conditioned responding to A is reduced when AB is presented because of stimulus generalization decrement. The size of this decrement depends on the similarity of the compound to the element. Likewise, the conditioned response to B is reduced. However, the responses to A and B also summate. Thus, enhanced responding is expected when the combined amount of stimulus generalization decrement is smaller than the amount of summation. If the size of the decrement is greater, then combining two separately conditioned elements will produce a smaller response than will either element presented alone.

If we assume that latent inhibition is an associative entity, then this analysis might be appropriate here. Quite clearly, with our parameters we are investigating a case in which the effects of generalization decrement are greater than summation of conditioned responding (and in Holland and Forbes's, 1980, experiment, the opposite was true, for some unknown reason). This account is not tirely satisfactory, because it allows for both a summation and a generalization decrement of latent inhibition. But it would seem that because stimulus similarity is the critical factor in determining which effect is achieved, if a set of parameters fails to produce summation of latent inhibition, summation of conditioning should also be absent. We have not tested this prediction with our parameters. But Pearce (1987) has also claimed that the reinforcer used might influence the similarity of elements through selective attention, and surely the reinforcer in latent inhibition might be different than that in conditioning. So perhaps in the present instance, the account makes no truly testable predictions.

It would be remiss of us not to mention that although we have ruled out an associative account of these experiments that relies on the analogy between latent inhibition and the mutual overshadowing of stimuli during compound exposure and conditioning (i.e., the overexpectancy phenomenon), there is another relevant associative explanation. Generalization decrement can be accounted for by the notion of a unique configural cue that is formed when two stimuli are compounded (Rescorla, 1973). This stimulus then behaves as a discrete associative element that is conditionable, and is subject to latent inhibition, as a separate entity. When animals are exposed to the elements

separately, latent inhibition forms to the elements but not to this unique configural cue, whereas when the elements are exposed as a compound, both the elements and the unique cue acquire latent inhibition. Thus, the rapid conditioning that is found when the individually exposed elements are combined during conditioning accrues mainly to the unique cue. This explanation begs the question, just what is the unique cue? The simplest answer is that it is simply a consequence of the perceptual properties of the configuration. As mentioned before, our data and those of Honey and Hall (1989) are most consistent with this notion. A perceptual mechanism can explain the configural cue in these experiments but cannot be offered as a reasonable explanation of Rescorla's (1973) original data from an experiment in which the elements of the compound came from different modalities.

Having said this, it must be acknowledged that associative accounts of latent inhibition have obtained support from phenomena other than distractor effects. In particular, Wagner's (1976, 1978, 1981) theory derives significant support from the observation (e.g., Channell & Hall, 1983; Hall & Honey, 1989a; Kaye, Preston, Szabo, Druiff, & Mackintosh, 1987; Lovibond, Preston, & Mackintosh, 1984) that latent inhibition is often reduced when the conditioning context differs from that used for preexposure. Wagner's theory readily accounts for this effect by arguing that latent inhibition depends upon the existence of a context-stimulus association that is not operative when the context is changed (see also Baker & Mercier, 1982a). Although the associative account of contextual effects has been the subject of some dispute (e.g., Baker & Mercier, 1982a, 1982b; Hall & Honey, 1989b; Hall & Minor, 1984), it remains the case that some alternative explanation for these effects needs to be developed if the associative interpretation is to be rejected entirely.

Similarly, it is by no means the universal case that distractor experiments involve the simultaneous presentation of the distractor and the target. In many experiments, the distractor has been presented after or paired with the end of the target stimulus, and a reduction of latent inhibition has been found (e.g., Best et al., 1979, Lubow et al., 1976, Matzel et al., 1988). Although it is possible to accommodate these findings within the perceptual explanation by claiming that the distractor interferes with the perceptual memorial representation of the target (cf. Pearce, 1987), the perceptual argument loses much of its parsimony. We should point out that we have tried to produce distractor effects in conditioned suppression using distractors that are not simultaneous with the target (e.g., Baker & Mercier, 1982a; and Mercier & Baker, 1985) and have found little evidence of any reduction in latent inhibition. In addition, in an unpublished experiment in our laboratory, we have tried to replicate the claim of Matzel et al. (1988) that irregular distractors are particularly effective, and we have failed. Our results are consistent with the perceptual argument. Until the enigma of why latent inhibition seems to be so robust in some laboratories and with some preparations and so disruptable in and with others is resolved, it would be safest to restrict our claims about perceptual mechanisms to simultaneous compounds.

In conclusion, it is worth summarizing what the present experiments have established. First, we not only failed to replicate Holland and Forbes's (1980) important result, but our results are in the opposite direction. Second, our results are inconsistent with any associative theory of latent inhibition that would claim that distractor effects are a simple effect of mutual overshadowing of stimuli and that this notion can be simply extended to the effect of element exposure onto compound conditioning. Third, the present results are consistent with the notion that distractor effects, as least with simultaneous compounds, can be readily understood using the principle of stimulus generalization decrement.

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