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The role of handling cues in the treatment preexposure effect in taste aversion learning

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Animals were injected with lithium chloride or physiological saline on four occasions prior to a single conditioning trial on which the taste of saccharin was followed by the injection of lithium chloride. On a subsequent two-bottle test for aversions to the saccharin water, it was found that animals preexposed to the lithium chloride formed weaker aversions than did animals preexposed to the physiological saline. Weakened aversions occurred independent of the amount of handling animals had experienced prior to the preexposure phase of the experiment. These findings indicated that experimenter-generated handling cues did not appear to play a role in mediating the treatment preexposure effect.

It has been observed that conditioned taste aversions can be either attenuated or blocked if, prior to the pairing of the ingested test substance with an aversion-inducing treatment, animals are given experience with the same or another aversion-inducing treatment (see Braveman, 1977, and Gamzu, 1977, for reviews). A recent explanation of this treatment preexposure effect has been proposed by Rudy, Iwens, and Best (1977). This explanation holds that nongustatory (environmental) cues that are present at the time of preexposure to the treatment become associated with the aversive aftereffects of the treatment. Subsequently, the formation of the taste-treament associations are blocked when animals consume a novel test solution in the presence of the nongustatory (environmental) cues and then are injected with the aversion-inducing treatment.

Rudy et al. (1977) have postulated further that in some experiments (e.g., Braveman, 1975) animals may have associated cues that were related to the treatment preexposure with the aversive aftereffects of the treatment. Specifically, they argue that in experiments in which animals are preexposed and trained in the same environment (i.e., in which there are no distinctive environmental cues that can become associated with the aftereffects of the treatment during preexposure), experimenter-generated handling cues could have been correlated with treatment preexposure and may have mediated the treatment preexposure effect by blocking subsequent taste-treatment associations. Indeed, in the Rudy et al. experiments animals were handled on 7 consecutive days prior to preexposure, a procedure which should reduce the salience of these cues and which should, in turn, reduce the likelihood that they would be assoicated with the preexposure injections of LiCl.

Unfortunately, Rudy et al. (1977) did not test this notion directly by varying the degree to which animals were familiar with the handling procedure prior to the preexposure phase of the experiment. As a result, in the present experiment we examined the role of experimenter-generated handling cues in the treatment preexposure effect by differentially familiarizing animals with the handling procedure that was used during preexposure and training. Based on the knowledge that animals associate novel conditioned stimuli (CSs) with unconditioned stimuli (USs) more readily than they associate familiar CSs with USs (e.g., Lubow, 1973), it was argued that animals for which the handling procedure was novel at the time of preexposure would more likely associate these experimenter-generated cues with aftereffects of the treatment and thus would more likely exhibit the treatment preexposure effect than animals for which the handling procedure was familiar. In the present experiment, then, animals were handled in a prescribed manner on 0, 7, 14, or 21 consecutive days prior to the onset of the preexposure phase of the experiment. If handling cues played an important role in mediating the treatment preexposure effect, then animals in Group 0 should show a maximal effect of treatment preexposure by forming very weak aversions, while animals in the remaining groups should show progressively less of the treatment preexposure effect and form progressively stronger aversions.

METHOD

Subjects

The subjects were 48 experimentally naive male rats of the Long-Evans strain that had been obtained from a commercial breeder. The animals were housed in individual stainless steel cages measuring 35 x 35 x 17 cm and weighed approximately 300-350 g at the start of preexposure.

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Apparatus

All training and testing took place in the animals' home cages. Injections of .3M LiCl or of 9% (w/v) saline were administered intraperitoneally at a dose of 1% body weight. During training and testing animals consumed a .15% (w/v) solution of sodium saccharin.

Procedure

The experiment was divided into four phases. During the first phase animals were handled on 0, 7, 14, or 21 consecutive days (N = 12/group). Handling consisted of opening the animals' cages, taking them out, and holding them in a manner that was similar to the way in which they would be held when they received injections during preexposure and training (i.e., dorsal side on the experimenter's palm and ventral side parallel to and aimed away from the floor). Animals that received no handling were not removed from their cages at this time but merely had their cages opened and closed.

The preexposure phase of the experiment began on the day after the last handling episode. The four groups of 12 animals were each divided into two groups of 5 and 7 animals, respectively. This division was based on whether they were preexposed (P) or not preexposed (NP). The five animals in each group that were preexposed received injections of LiCl on each of 4 days. The nonpreexposed animals received equivalent injections of physiological saline. Injections were administered each day between 0800 and 0900 h once every third day. At approximately 1500 h on each of the 4 preexposure days, all animals were removed from their cages, held by the experimenter, and given orally 1 cc of tap water from a syringe. Animals were then replaced in their cages and given 20-min access to tap water from their normal water bottles.

For 7 days after the last preexposure, animals were given tap water from standard water bottles in their home cages for 20 min/day starting at approximately 0900 h. At approximately 0900 h of the eighth day all animals were given, orally from the syringe, 1 cc of the saccharin solution (S). All of the animals preexposed to the LiCl during the previous phase of the experiment received injections of the LiCl (L) immediately after they finished drinking the saccharin water and were designated as Group P/S-L. Three of the seven animals that received the saline injections during preexposure also received injections of LiCl during the training phase of the experiment, and they were designated as Group NP/S-L. The remaining four animals that had received saline injections during preexposure were also injected with saline (Na) on the training trial, and they were designated as Group NP/S-Na.

Three days after the training trial, animals were given a two-bottle preference test between saccharin water and familiar tap water at approximately 0900 h. The preference test lasted for 20 min and the amount of each solution consumed was measured to the nearest .5 ml.

RESULTS AND DISCUSSION

A 3 (treatment) by 4 (handling) factorial design ANOVA on the total amount of saccharin plus tap water consumed on the preference test by animals in the various groups revealed only a significant main effect due to treatment [$F(2,36) = 9.48$, $p < .01$]. Post hoc Newman-Keuls comparisons indicated that the animals preexposed to the LiCl drank more than animals preexposed to the physiological saline. To correct for this discrepancy, a preference ratio was calculated for each animal by dividing the amount of saccharin water consumed by the total amount consumed.

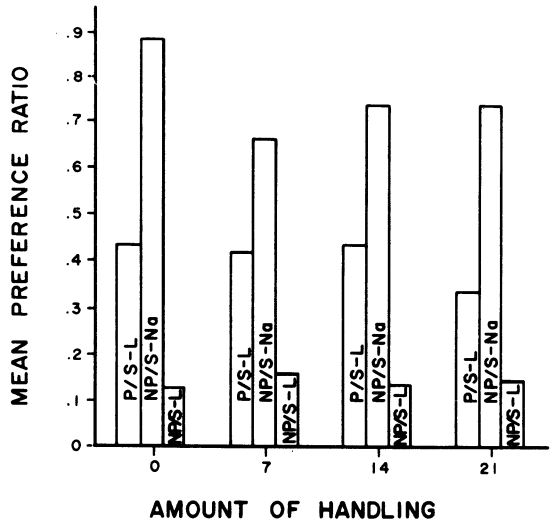

Figure 1. Mean preference ratios for animals that were handled on 0, 7, 14, or 21 occasions prior to preexposure with lithium chloride (P) or with physiological saline (NP). On the training trial, consumption of 1 cc of saccharin water (S) was followed by an injection of either lithium chloride (L) or physiological saline (Na).

The results of this experiment in terms of preference ratios are summarized in Figure 1 for the various groups. Inspection of this figure indicates a pattern of results that is similar from one level of the handling variable to the next. Based on the absolute size of the preference scores it appears that, independent of the amount of handling animals received prior to the preexposure phase of the experiment, the strongest aversions were formed by animals that had not been preexposed to the LiCl (i.e., those in Group NP/S-L), weaker aversions were formed by animals that had been preexposed to LiCl (i.e., those in Group P/S-L) and no aversions whatsoever where formed by animals that had not been preexposed with LiCl and that had been trained with physiological saline (i.e., those in Group NP/S-Na). In other words, preexposure to LiCl on four occasions attenuated the formation of conditioned taste aversions. Statistical analysis of the preference ratios by means of a 3 (treatment) by 4 (handling) factorial design ANOVA support this conclusion in that there was only a significant main effect due to treatments [$F(2,36) = 33.48$, $p < .001$]. Comparisons among the treatments across all levels of the handling variable using the Newman-Keuls technique revealed that animals in Group NP/S-Na had reliably greater preference ratios than animals in either of the other two groups (all ps $< .01$). Additionally, preference ratios for animals in Group P/S-L were reliably greater than those for animals in Group NP/S-L (all ps $< .01$).

These results indicate, then, that familiarity with the handling procedure appears not to determine whether or not treatment preexposure will disrupt the formation of conditioned taste aversions. In the present experi-

ment animals for whom the handling procedure was familiar at the time of treatment preexposure exhibited the treatment preexposure effect as well as animals for which the handling procedure was novel. These findings are entirely consistent with results of a study reported by Berman and Cannon (1974), in which animals were preexposed to and trained without being handled. Even without the benefit of novel exteroceptive or of experimenter-generated cues, Berman and Cannon reported disruptions of ethanol-induced aversions to saccharin water in animals that had been preexposed to ethanol.

The fact that the present results are not consistent with the suggestion made by Rudy et al. (1977) that handling cues, in the absence of other salient nongustatory cues, mediate the treatment preexposure effect by blocking taste-treatment associations should not detract from the potential importance of other nongustatory cues in the treatment preexposure effect. Other experiments (e.g., Batson & Mustian, Note 1; Braveman, Note 2) have shown that environmental cues do appear to play an important role in the treatment preexposure effect. For example, Braveman (Note 2) found that changes as subtle as reducing the illumination of the home cage environment are sufficient to mediate the treatment preexposure effect. However, Braveman also noted that the process that mediates the effect may not be associative blocking, since the environmental stimuli which appear to block taste-treatment associations may not be secondarily aversive.

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