

Short Reports

Lithium Chloride and Delta-9-THC Lead to Conditioned Aversions in the Pigeon

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Abstract. Conditioned aversive effects of Δ^9 -tetrahydrocannabinol (THC) and lithium chloride (LiCl) were demonstrated in pigeons. Pigeons injected with 0.15 M LiCl showed a reduction in preference for red water compared to pigeons injected with NaCl ($P < 0.001$). Pigeons injected with saline or vehicle showed the same preference for red water while the pigeons injected with 2.0 mg/kg of THC showed a decreased preference ($P < 0.05$).

Key words: Cannabinoid – THC – Lithium chloride – Conditioned taste aversion

The main purpose of this study was to investigate whether THC can lead to aversions in the pigeon. Intraperitoneal injections of THC in doses of 0.5 mg/kg or greater are aversive for the rat (Kay 1975), whereas from anecdotal evidence the typical dose is nonaversive for humans. With few exceptions (e.g., Ferraro 1972) studies of the effects of THC on rats have used aversive doses and thus are weak models for the human situation. The study of THC in other infrahuman species may have the same drawback. As far as we know, no one has studied the aversiveness of THC in animals other than the rat, and no one has studied conditioned aversions in the pigeon. Thus it is unknown whether THC can lead to aversions in the pigeon.

Materials and Methods

Subjects. From Palmetto Pigeon Plant, Sumter, SC, USA, 45 white Carreaux pigeons were obtained and individually housed.

Apparatus. Graduated Richter tubes, clipped onto the animal's home cage in the same location as the water trough, were used to present water during treatment. During testing two Richter tubes were

attached, side-by-side, to the home cage. Colored water consisted of five drops of red food coloring per 100 ml of water.

Procedure. The pigeons were water deprived and taught to drink their daily ration of water from Richter tubes. The drinking time allowed 4 min per day throughout the experiment. To reduce neophobia (Czaplicki et al. 1976), the birds were then given red water during their daily drinking period for three consecutive days. Six days of two-bottle, plain-water-versus-plain-water testing followed.

On treatment day of Phase A, two groups of 12 birds each were formed. Each bird was given red water in the middle position and then was injected (IM) with either 0.15 M LiCl or 0.15 M saline solution at a volume of 2% weight (20 ml/kg).

On treatment day of Phase B, three groups of 7 birds each were formed. Each bird was given red water as in Phase A and then was injected (IM) with either saline as in Phase A, or 2 mg/kg of THC in a vehicle of propylene glycol and ethanol (19:1), or with the vehicle alone.

In both phases, 2 days of plain water were given for recovery. Then 4 consecutive days of two-bottle-red-water-versus-plain-water testing followed. The position of the red water was alternated over the four days (R-L-R-L). Preference scores (red water consumption/total water consumption) were calculated for each bird on each test day and then averaged over the 4 days.

Results

Phase A. The preference score for red water was 0.605 for the saline group and 0.207 for the lithium group. The difference was significant at the 0.001 level, $t(22) = 4.15$.

Phase B. The preference score for red water was 0.537 for the saline group, 0.392 for the vehicle group, and 0.237 for the THC group. The data were analyzed by an analysis of variance with two independent comparisons: the saline and vehicle groups did not differ, $F(1,18) = 1.60$, $MS_e = 18.37$; the saline and vehicle groups had a greater preference for red water than the THC group, $F(1,18) = 5.25$, $P < 0.05$, $MS_e = 18.37$.

Discussion

The results of Phase A represent the first reported conditioned aversion in the pigeon.

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The nonsignificant difference between the saline and vehicle groups of Phase B indirectly supports the conclusion that the vehicle is not aversive for pigeons. The significant difference for the second comparison (the saline and vehicle groups against the THC group) demonstrates that a dose of 2.0 mg/kg of THC is sufficiently noxious to produce a conditioned aversion in pigeons. That both LiCl and THC led to an aversion demonstrates the generality of the conditioned aversion phenomenon in pigeons. That THC leads to aversions in rats (Kay 1975) and pigeons suggests THC is aversive to many species.

Conditioned aversions in rats are called conditioned *taste* aversions because only gustatory cues have been sufficient to produce an aversion (Garcia and Ervin 1968). The concepts of preparedness (Seligman 1970) and belongingness (Rozin and Kalat 1971) predict that whatever cues are eating-related for a given animal should produce an aversion in that animal. Because the pigeon searches for food and water with a highly developed visual sense we used a visual cue as a conditioned stimulus rather than a gustatory one. The present results corroborate the above prediction. However, we found it necessary to habituate the pigeons to the novel color of the water, contrary to the

usual report that a novel stimulus is more effective (Rozin and Kalat 1971).

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References

- Czaplicki JA, Borreback DE, Wilcoxon HC (1976) Stimulus generalization of an illness-induced aversion to different intensities of colored water in Japanese quail. *Anim Learn Behav* 4:45–48
- Ferraro DP (1972) Effects of delta-9-THC on simple and complex learned behavior in animals. In: Lewis M (ed) *Current research in marihuana*. Academic Press, New York
- Garcia J, Ervin ER (1968) Gustatory-visceral and telereceptor-cutaneous conditioning — adaptation in internal and external mileus. *Comm Behav Biol* 1:389–415
- Kay EJ (1975) Aversive effects of repeated injections of delta-9-THC in rats. *Psych Rep* 37:1951–1954
- Rozin P, Kalat J (1971) Specific hungers and poison avoidance as adaptive specializations of learning. *Psych Rev* 78:459–486
- Seligman MEP (1970) On the generality of the laws of learning. *Psych Rev* 77:406–418

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