J. Range Manage.
47:123-126, March 1994

Social facilitation influences cattle to graze locoweed

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Abstract

Many ranchers claim that if a cow starts eating locoweed, she will teach others to eat it. Three grazing trials were conducted to evaluate the role of social facilitation in starting cattle to graze locoweed. The first trial was conducted near Gladstone, N.M., using mature cows grazing woolly locoweed (*Astragalus mollissimus* var. *mollissimus* Torr). The second trial was conducted on the Raft River Mountains in northwestern Utah, using yearling cattle grazing white locoweed (*Oxytropis sericea* Nutt). The third trial was conducted to determine if aversion-conditioned yearling cattle would consume white locoweed when placed with cattle that were eating locoweed (loco-eaters). Cattle conditioned to eat locoweed and naive animals in trials 1 and 2 first grazed in separate pastures to evaluate their initial acceptance of locoweed. The groups in the respective trials then were placed together to evaluate the influence of social facilitation on locoweed consumption. Locoweed consumption was quantified by bite count. Naive cattle in trials 1 and 2 sampled small quantities of locoweed while grazing separately. However, they greatly increased locoweed consumption when placed with the loco-eaters. Aversion-conditioned cattle in trial 3 did not consume locoweed while grazing separately. When placed with loco-eaters, they gradually increased consumption of white locoweed, in contrast to the immediate acceptance of locoweed by naive cattle in trials 1 and 2. The aversion extinguished and averted animals eventually accepted white locoweed at levels comparable to loco-eaters. Results of this study demonstrate that social facilitation can cause cattle to start eating locoweed.

Key Words: social learning, conditioned food aversion, poisonous plant, woolly locoweed (*Astragalus mollissimus* var. *mollissimus* Torr), white locoweed (*Oxytropis sericea* Nutt).

Stockmen claim that animals eating locoweed influence others to eat it (Marsh 1909, Patterson 1982). Social facilitation has been defined as "the initiation of a particular response... while observing others engaged in that behavior" (Galef 1988). This phenomenon has been extensively studied in lab animals. Galef (1986) concluded that "rats will abandon, to a greater or lesser extent, reliance on information it personally has collected concerning the value of potential foods, in favor of information acquired from others". Social facilitation has been observed among grazing cattle and sheep in conditioned food aversion studies. When animals that have been averted to a particular plant or food are placed with nonaverted cohorts which are eating that food, the averted animals begin to eat, and the aversion to that food extinguishes (Lane et al. 1990, Ralphs and Olson 1990, Provenza and Burritt 1991). Social facilitation appears to be a robust phenomenon that influences animals to sample foods they observe others eating. If the food provides positive nutritional feedback without immediate negative consequences, the animal will continue eating that food (Provenza et al. 1994).

Three grazing trials were conducted in areas that traditionally have locoweed poisoning problems. The objective was to determine if social facilitation would cause cattle to start grazing locoweed. Two trials used cattle that were not familar with the respective locoweed species. Their consumption patterns were evaluated when they grazed alone and when they were placed with cohorts that were eating locoweed. The third trial included yearling cattle adversely conditioned to avoid locoweed to determine if social facilitation would overcome the aversion. We hypothesized that the naive and averted cattle would not consume locoweed while grazing separately, but when they were placed with other cattle that were eating locoweed, social facilitation would influence them to start grazing locoweed.

Methods

The first trial was conducted near Gladstone, N.M., on woolly locoweed (*Astragalus mollissimus* var. *mollissimus* Torr.) in 1991. Mature cows were used in this trial. The second trial was conducted on the Raft River Mountains in northwestern Utah in 1992. Yearling steers and heifers grazed on white locoweed (*Oxytropis sericea* Nutt.). The third trial was an aversion trial conducted at the same location as trial 2.

Gladstone

This trial was conducted in conjunction with a larger grazing study on woolly locoweed in the spring of 1991 (Ralphs et al. 1993). The study site had been farmed until 1963, then seeded to blue grama [*Bouteloua gracilis* (H.B.K.) Lag. ex Steudel], sideoats grama [*B. curtipendula* (Michx.) Torr.], and yellow sweet clover [*Melilotus officinalis* (L.) Pallas]. Squirreltail [*Elymus elymoides* (Raf.) Swezey], three-awns (*Aristida* spp.), and broom snakeweed [*Gutierrezia sarothrae* (Pursh) Britt. & Rusby] established naturally. A population outbreak of woolly locoweed occurred in fall 1989, and a dense infestation remained in spring 1991.

Four cows (Hereford, Angus, and their cross, 360 to 500 kg) grazed this infested pasture from 28 March to 5 May and were readily eating woolly locoweed (loco-eaters). Four new cows (naive) from another grazing study were brought to Gladstone to evaluate their acceptance of woolly locoweed. A 16-ha pasture was partitioned and the 2 groups grazed separately in 8-ha pastures for a 6-day period to evaluate the initial acceptance of woolly locoweed by the naive cows without the influence of social facilitation. The partition fence was then removed and the groups grazed

The authors wish to thank Sharla Hennigan, Justin Williams, and Brent Bunderson for assistance in caring for the cattle and collecting the data.
Manuscript accepted 19 Jun 1993.

together for a 12-day period to measure the influence of social facilitation on consumption of woolly locoweed by naive cows.

Diets were quantified by a bite count technique (Lehner 1987). Each animal was observed for 5-min periods, the number of bites of major forage classes (grass, forb, and locoweed) were counted, and the percentage of the diet was calculated. Daily observations were taken during the morning and evening grazing sessions each day during the first period when the groups were separate, and every other day during the second period when the groups were together.

Raft River

This trial was conducted with yearling cattle that grazed white locoweed on the Raft River Mountains in northwestern Utah in August 1992. The site was a flat mountain top at an elevation of 2,900 m. The range site was a high mountain loam site and dominant species included Idaho fescue (*Festuca idahoensis* Elmer), mutton grass (*Poa fendlariana* (Stend.) Vasey), white locoweed, western yarrow (*Achilea lanulosa* Nutt.), and orange sneezeweed (*Helenium hoopesii* Gray).

Eight mixed Hereford × Angus × Chianina steers and heifers (200 kg ± 5 SE) were randomly allocated to 2 groups of 4 animals each. Animals in group 1 (loco-eaters) were preconditioned to eat white locoweed by mixing small quantities of fresh-picked white locoweed with fresh alfalfa, and gradually increasing the proportion of locoweed until the calves would eat it alone. Animals in group 2 (naive) were not exposed to locoweed until they were taken to the Raft River Mountain field grazing trials.

In the field grazing trial, the loco-eater group and the naive group grazed separately for a 5-day period in adjacent 1.2-ha pastures to evaluate their propensity to graze white locoweed without the influence of social facilitation. The partition fence was then removed and the groups grazed together for a 7-day period to evaluate locoweed consumption under the influence of social facilitation. Cattle were observed by 2 observers whenever they were actively grazing. Diets were quantified by bite count as described above.

Aversion Conditioning and Grazing Trial

The prior 2 trials involved a casual social influence to start eating a novel food. This trial involved acceptance of a food that was distasteful, and which the cattle associated with making them ill. Food aversion involves both the conscious memory of the food that causes illness, and also a subconscious hedonic shift where that food becomes distasteful (Garcia et al. 1985, Provenza et al. 1993).

Four yearling cattle (averted) were conditioned to avoid eating white locoweed through the process of conditioned food aversion. Conditioning of the animals took place at the ARS Poisonous Plant Research Laboratory in Logan. Each animal was offered 500 g fresh picked white locoweed for 5 min. Two animals readily ate the locoweed, but 2 were reluctant. The influence of social facilitation was used to entice the slow eaters to consume locoweed. One animal that had readily eaten locoweed was placed together with one that had not eaten locoweed and offered 2 kg fresh locoweed. All animals readily consumed locoweed in this setting. The animals were then gavaged with lithium chloride (LiCl) 200 mg/kg BW to induce gastrointestinal distress. The animals subsequently associated the induced illness with the taste of white locoweed. The aversion was tested and reinforced in a series of paired feeding trials at 2 to 4 day intervals. Each conditioned animal was randomly paired with a loco-eater (from the second trial) and offered 2 kg fresh locoweed for 5 min. If averted animals consumed any locoweed, they were dosed again with LiCl.

The field grazing trial was conducted on the Raft River Mountain, and the site and design were similar to trial 2. The averted group (n = 4) and loco-eater groups (n = 4) grazed separately for 4 days in adjacent pastures to verify the aversion to white locoweed by the conditioned group. The 2 groups were then placed together in the same pasture for 4 days to determine if social facilitation was strong enough to extinguish the aversion. Diets were quantified by bite count as described above.

Data Analysis

Each trial was analyzed separately. The percentage of locoweed bites was compared by analysis of variance (ANOVA) in a split-plot design. Animal treatment groups were the main plot, and were tested by the animals-within-group factor. Period (separate and together) was the split-plot and was tested by the period-by-animal-within-period interaction, as was the period-by-treatment interaction. Days within periods and the treatment-by-day-within-period interaction were tested by the residual error. There was a treatment-by-period interaction in ($P<0.05$) in all 3 trials. The model was reduced and groups were compared in each period, and the locoweed consumption by the naive or averted group was compared over periods. Individual animals were considered experimental units. Percentage data of the diets were transformed by arcsin for analysis, but the nontransformed means are presented in the figures.

Standing crop was estimated in each of the separate pastures at the beginning of each trial. Two paced transects bisecting the pastures were stepped off and 10 quadrats (1 by .25m) were systematically located along each transect. Forage classes (grass, forbs, and locoweed) were clipped, dried in a forced air oven for 48 hours at 60° C, and weighed. Mean standing crop and standard errors are presented in Table 1.

Table 1. Standing crop (kg/ha^{-1} ± standard error) of separate pastures at the beginning of each grazing trial.

Grazing trial	Group	Grass	Forb	Locoweed	Total
		kg/ha^{-1}			
Gladstone	Loco-eater	482 ± 30	167 ± 23	186 ± 31	835 ± 57
	Naive	246 ± 29	5 ± 2	183 ± 136	434 ± 144
Raft River	Loco-eater	356 ± 30	540 ± 84	188 ± 60	1084 ± 110
	Naive	1080 ± 112	460 ± 106	212 ± 84	1752 ± 174
Aversion	Loco-eater	784 ± 74	328 ± 33	324 ± 88	1436 ± 146
	Averted	684 ± 76	516 ± 58	344 ± 106	1544 ± 134

Results

Gladstone

Woolly locoweed is not very palatable to cattle (Marsh 1909). At the beginning of the larger grazing study preceding this social facilitation trial, the Gladstone cows were reluctant to graze woolly locoweed (Ralphs et al. 1993). They were forced to start grazing woolly locoweed in a grazing pressure experiment that confined them to a small pasture where the grass was depleted by the end of the 10-day trial. When the cows were later released into a larger pasture where feed was not limiting, they continued eating woolly locoweed for 23% of observed bites.

In the present study, there was a group-by-period interaction in the amount of woolly locoweed consumed ($P = 0.003$). During the first period when the groups were separate, loco-eaters consumed woolly locoweed for 42% of bites while the naive group grazed very little woolly locoweed (Fig. 1). When the groups were placed together, the naive group increased consumption of woolly locoweed ($P = 0.01$) to levels that were similar to the loco-eater group (Fig. 1). There was no difference between the groups while they

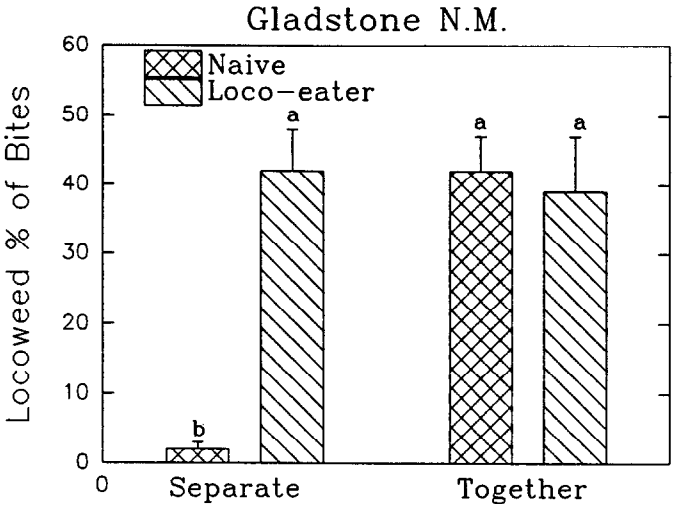

Fig. 1. Mature cattle consumption of woolly locoweed at Gladstone, N.M. Loco-eater and naive groups grazed separately for the first 6 days, then grazed together for 12 days to evaluate the influence of social facilitation. Error bars are standard errors. The treatment group-by-period (separate or together) interaction was significant (P = 0.003).

grazed together (P = 0.55). There was a group-by-day-within period interaction (P = 0.01), that represents the variability in locoweed consumption by the loco-eaters in the first period, ranging from 20 to 70% of recorded bites.

Raft River

There was also a group-by-period interaction in the amount of white locoweed consumed in this trial (P = 0.007). Loco-eaters consumed white locoweed for 25% of their bites in the first period when they grazed separately, while the naive group consumed locoweed for only 3% of bites (Fig. 2). Most of the locoweed

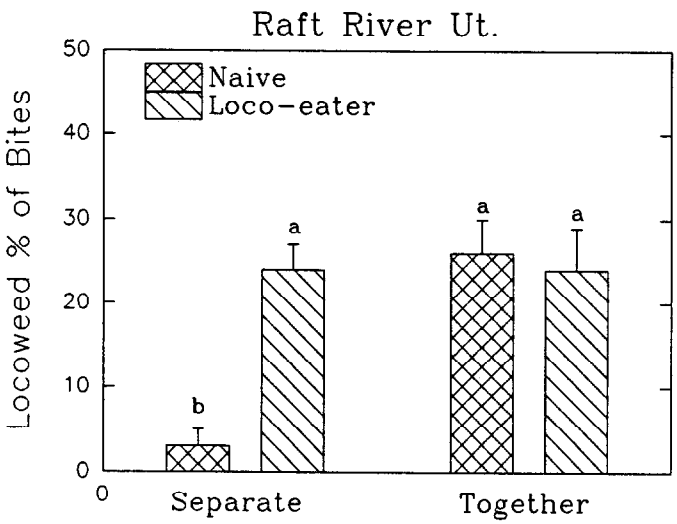

Fig. 2. Yearling cattle consumption of white locoweed on the Raft River Mountain, Utah. Loco-eater and naive groups grazed separately for the first 5 days, then grazed together for 7 days to evaluate the influence of social facilitation. The treatment group-by-period (separate or together) interaction was significant (P = 0.007). Error bars are standard errors.

consumed by the naive animals occurred on the first day, then they abstained for the remainder of the period.

When the groups were placed together in the second period, the naive animals immediately increased consumption of white locoweed (P = 0.01). There was no difference in white locoweed consumption between the 2 groups when the grazed together (P = 0.83). On the morning the groups were placed together, 2 naive animals were observed watching loco-eaters graze locoweed. These animals tried it and continued eating it. The other 2 naive animals must have observed others eating locoweed, because all naive animals were eating as much white locoweed as the loco-eaters by the end of the first day.

There were differences in locoweed consumption among days-within periods (P=0.01). Locoweed consumption by the loco-eater group ranged from 10 to 35% of recorded bites in the first period, and from 10 to 50% of recorded bites by both groups in the second period.

Aversion Trial

During the conditioning phase, all averted animals consumed fresh picked locoweed the first day, prior to dosing with LiCl. Following dosing, most animals abstained. One steer took locoweed for 84 bites and another took 25 bites in the subsequent paired feeding trials and were dosed a second time with LiCl.

There was a group-by-period interaction (P = 0.01) in this field grazing trial. The averted group did not consume locoweed while the groups were separated, but loco-eaters consumed white locoweed for an average of 33% of their bites (Fig. 3). When the groups

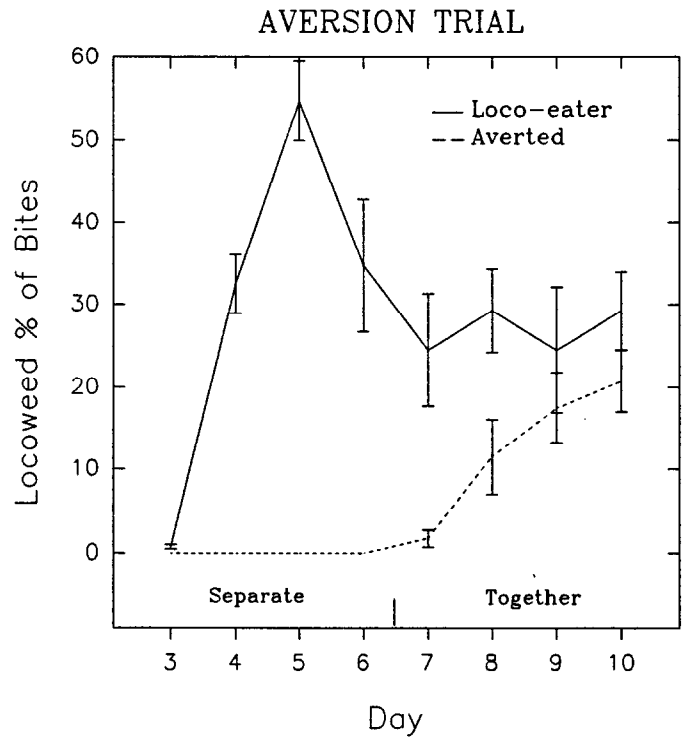

Fig. 3. Aversion grazing trial. Loco-eater and averted groups grazed separately for 4 days and together for 4 days to evaluate the influence of social facilitation. The treatment group-by-period (separate or together) interaction was significant (P = 0.01). Error bars are standard errors.

were placed together, the averted group gradually increased locoweed consumption over the 4 day period to where it was similar to the loco-eater group. There was a group-by-day-within period interaction (P = 0.01) that supports the increasing consumption of locoweed by the averted group in the second period. The increase in white locoweed consumption over time indicates a gradual acceptance of white locoweed, in contrast to its immediate acceptance of it by the naive cattle in the other 2 trials. Social facilitation was strong enough to influence the averted animals to sample the plant they associated with past illness. When no adverse effects

occurred they gradually increased consumption and extinguished the aversion.

Discussion

Social facilitation is an extremely strong force influencing animals to consume food they see others eating. Naive animals in all 3 trials started or increased locoweed consumption when placed with the loco-eater group. Trials 1 and 2 illustrate the influence of social facilitation in casual acceptance of a new food. The aversion trial was a severe test in which animals overcame the aversion to locoweed, even though there was an abundance of grass and forbs to select from (Table 1).

There was some degree of confounding between experience and social facilitation in this study. It is not known whether the naive animals would have eventually accepted locoweed if they were given more time alone. However, the dramatic increase in locoweed consumption by the naive groups when they were placed with loco-eaters in trials 1 and 2, and the extinction of the aversion in trial 3, strongly suggests that social facilitation played a major role in the animals acceptance of locoweed.

Considerable research has been conducted on social influences in diet selection by rats (Galef 1991). Simple exposure to a food will not create a preference for that food. However, exposure of an observer rat to the same diet in the presence of a demonstrator rat increased the observers preference for that diet. Even lingering food ques on the demonstrator (odor on breath or particles of food on fur) caused the observer rat to form a preference for that food. Social facilitation goes beyond forming preferences to novel palatable foods. Rats will greatly increase intake of unpalatable foods following interaction with cohorts that had fed on it. Rats will also abandon a learned aversion to a food following interaction with conspecifics that have eaten that food.

We found that social facilitation was a strong force influencing cattle to graze larkspur. In fact, it has been the major obstacle in maintaining aversions to larkspur in field grazing trials where averted and control animals grazed together (Ralphs 1992, Ralphs and Olson 1992). In studies using sheep, aversions to palatable shrubs and grain have been partially extinguished by social facilitation (Burritt and Provenza 1989, Provenza and Burritt 1991, Thorhallsdottir et al. 1990). Galef (1985) stated that "toxicosis-induced aversions to food is the most potent known experimental determinant of diet selection." Studies conducted on the diets of rats, our studies with cattle, and feeding studies with sheep, have repeatedly shown that social facilitation is so powerful that it will overcome toxicosis-induced aversions to the target foods.

Foraging animals continually sample foods in order to track the nutrient status of the foods in their environment (Launchbaugh et al. 1993). It appears that when information obtained from conspecifics conflicts with the animals perception of a food, that food is willingly sampled to reassess its value. Galef (1988) stated that while social influences may facilitate acquisition of a behavior, continuation of that behavior depends on its consequence to the individual. Continued acceptance or rejection of a food is dependent upon its postingestive consequences and feedback (Provenza et al. 1994, Garcia et al. 1985). Highly nutritious foods provide positive nutritional feedback, and their relative palatability increases. Low quality foods, or foods containing toxis that affect the gastrointestinal tract, produce negative feedback, and their relative palatability declines. The continued acceptance and consumption of poisonous plants presents a paradox. The positive nutritional consequences from locoweed in this study, and larkspur in the reported aversion studies apparently are stronger than the negative consequences of delayed intoxication.

Conclusion

Social facilitation appears to be a very strong influence on the acceptance of novel foods by animals and in shaping food preferences and selection. The results of this study demonstrated that the social influence of cattle eating locoweed caused naive cattle to start grazing it. Many ranchers in locoweed-infested areas watch their cattle closely and remove those they see grazing locoweed. This reduces the incidence of social facilitation influencing other cows to eat locoweed, and prevents the progression of locoweed intoxication.

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