



Sheep reared with goat interacting with stimulus goats in species affinity test.

Species affinities in domestic sheep and goats

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Although sheep exhibit a stronger tendency to follow their own kind, goats are the more social of the two species.

The saying “birds of a feather flock together” describes an important characteristic of group-living animals. However, the process by which animals develop an attraction for members of their own species is not fully understood. Studies on the establishment of social affinities in certain species of birds (*e.g.*, domestic fowl, ducks and geese, and so on) have revealed that species and sexual preferences are formed very early in life and, in most species, remain fixed despite exposure to other closely related species in later life.

Studies on mammals have, likewise, suggested that social preferences are learned; but the extent to which these attachments can be changed or reversed in later life has received only scant attention.

Investigations of this question were recently undertaken using domestic sheep and goats. Subjects consisted of 27 Dorset x

Targhee male lambs and 27 male kids, representing Alpine, Saanen, Toggenburg, and LaMancha goat breeds. The sheep were obtained from the U.C. Hopland Research Field Station and the goats from Laurelwood Acres, Ripon, and Robin Pease, Manteca.

The lambs and kids were taken from their mothers at birth (before suckling) during a 10-day period in early March 1977 and isolated during transfer to the U.C., Davis, campus. Upon arrival, 15 lambs were paired with 15 kids, while the remaining 12 lambs and 12 kids were placed in same-species pairs (control subjects). Subjects were initially housed in 1.75 x 0.59 x 1.24 m (5.7 x 1.9 x 4.1 ft) wooden enclosures providing visual and physical isolation from adjacent pairs. Heat lamps provided warmth.

Each animal was bottle-fed cow-colostrum for 24 hours following birth, followed

by ad-libitum feeding of Land-O-Lakes Lamb Milk Replacer until weaning (5 to 7 weeks of age). The milk replacer was available from nipples attached by tubing to gallon jugs affixed to the outside of the pens. Alfalfa, grain, and normal additives were available starting at 2 weeks of age.

At weaning the pairs were moved to larger wooden enclosures—2.80 x 1.75 x 1.45 m (9.2 x 5.7 x 4.8 ft)—which also provided physical and visual isolation from adjacent pairs.

The test area consisted of a 60 m x 27 m (197 x 89 ft) pasture containing stimulus herds of six male goats and six rams physically segregated in two 9-m (29.5-ft) diameter wire enclosures, 27 m (88.6 ft) apart (see figure). The stimulus herds were of the same age and breeds as the test subjects.

Starting at about 8 months of age and continuing for about 8 weeks (November

and December) subjects were individually released into the test area at sunset and observed for three or four 1-hour periods the following day (sunrise, mid-morning, and early and late afternoon). After testing, each subject was returned to its respective enclosure and a new animal introduced. The order of testing of the experimental and control sheep and goats was randomized.

Species affinities were primarily determined by the time the test subjects spent in proximity to the stimulus sheep and goats (within 1 m of each stimulus enclosure).

On March 1 the test subjects were removed from their isolation chambers and maintained as a single group for 5 weeks. On April 5 the sheep and goats were segregated into separate pastures some distance apart. After 34 to 90 days of living only with members of their own species, all subjects were retested using the same procedure as employed initially.

The test subjects were strongly attracted to the stimulus herds as they spent an average 82.3 percent of their time (while observed) within 1 meter of the two stimulus animal enclosures. Neither treatments nor species differed in this regard (Kruskal-Wallis $H = 2.9$, $df = 3$). In addition, nearly all of the subjects displayed a clear preference for one of the two stimulus herds. During the combined total time spent at the two stimulus enclosures, 49 of 51 subjects spent more than 75 percent of their time with one of the two stimulus groups.

Experimental sheep reared with goats spent a significantly greater percentage of

time with the stimulus goats than did the control sheep (Mann-Whitney $U = 26.5$, $P < 0.02$; see table 1). Likewise, the experimental goats reared with sheep spent significantly more time at the stimulus sheep enclosure than did the control goats ($U = 25.0$, $P < 0.02$). In fact, the sheep reared with goats behaved like goats reared with goats and, conversely, the goats reared with sheep behaved like sheep reared with sheep. Naturally, the two control populations differed in their preferences in the expected directions ($U = 18.0$, $P < 0.02$).

The experimental subjects retested following 34 to 90 days exposure to same-

species flocks demonstrated a reversal of species attachments (see table 1). Experimental and control sheep no longer differed in their preference for the stimulus sheep ($U = 52.0$). Likewise, the preferences of experimental and control goats were similar ($U = 41.0$). Control sheep and goats again exhibited significantly different affinities for the two stimulus herds ($U = 17.0$, $P < 0.02$).

Roughly half of the retests were conducted in the month of May and half in June and early July. It was noted that the reversal of species preferences was more complete for experimental goats tested after 57 to 90

Sheep reared with goat fights with stimulus goat. Insert: Senior author replenishes supply of milk replacer for lamb-kid pair.



Pre-weaning rearing enclosures, showing sheep-goat pairs.



days of same-species cohabitation than for those tested earlier ($U = 8.0, P < 0.04$). A similar trend was noted for the experimental sheep ($U = 9.5, P < 0.12$). Thus, it was concluded that roughly 60 to 90 days of exposure to same-species herds is sufficient to reverse relatively long standing social preferences. The process of socialization in these species is not rigidly fixed by early social experiences and is somewhat flexible even during adulthood.

Other results

Immediately following the initial tests, nine pairs (five experimental goat-sheep pairs, three control sheep pairs, and one control goat pair) of animals were tested as duos rather than individually. Pair-mates stayed very close to each other (within 3 meters 90 percent of the time) and spent only half as much time with the stimulus herds as when tested alone (41.3 vs. 89.5%, $P < 0.001$). Seven of the nine pairs consisted of partners that had shown strong preferences for opposite stimulus herds during the initial tests. When tested in pairs the two animals behaved as a unit, differing in their choice of stimulus herds an average 6.3 percent of the time. Among experimental pairs more time was spent with the stimulus goats than stimulus sheep (75.0 vs. 25.0%).

It was noted in both initial tests and retests that the stimulus goats were more attractive to the test subjects than the stimulus sheep (see table 2). In the initial tests, three of eleven control sheep exhibited clear-cut preferences for the stimulus goats even though they had no prior experience with this species. In the retests, four of nine control sheep spent more than 75 percent of their choice time at the stimulus goat enclosure. Experimental goats, even though

reared with sheep, were only weakly attracted to sheep in the initial tests. Differences in the behavior of the stimulus herds could explain this disparity. When a test subject was first placed in the experimental pasture, the stimulus goats showed an increase in vocalizations and sexual activity and would often pace along and rear on the enclosure fence near the test animal. In contrast, the stimulus sheep were more inactive and generally

ignored the test subject.

The relatively dynamic social nature of goats was evident throughout the course of this study. Although sheep may exhibit a stronger tendency to follow their own kind, this and other studies by the authors have supported the hypothesis that goats are the more social of the two species.

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TABLE 1: Comparison of Control and Experimental Sheep and Goats for Percent Time Spent with Stimulus Sheep (SS) and Stimulus Goats (SG)

	N	̄ Percent time with SS		̄ Percent time with SG	
		total observed time	total time with both stimulus herds	total observed time	total time with both stimulus herds
Initial tests					
Sheep					
Experimental	15	5.0	5.5	84.5	94.5
Control	11	62.2	68.3	26.5	31.7
Goats					
Experimental	15	24.6	40.0	45.2	60.0
Control	10	3.3	5.9	78.2	94.1
Retests					
Sheep					
Experimental	12	29.3	48.3	33.1	51.6
Control	9	31.8	47.4	34.0	52.5
Goats					
Experimental	13	17.5	39.8	17.1	60.0
Control	10	4.6	11.8	34.1	88.1

TABLE 2. Percent of Total Choice Time Spent with Stimulus Sheep (SS) and Stimulus Goats (SG) for Subjects Reared with Sheep Versus Goats

	Reared with sheep (CS and EG)*	Reared with goats (ES and CG)*	All subjects
Initial tests			
̄ percent time with SS	54	6	30
̄ percent time with SG	46	94	70
Retests			
̄ percent time with SS	43	32	37
̄ percent time with SG	57	68	63

*ES = experimental sheep; CS = control sheep; EG = experimental goats; CG = control goats

