THE RESPONSE OF LLAMAS (*LAMA GLAMA*) TO FAMILIAR AND UNFAMILIAR HUMANS

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ABSTRACT: The current study explored the response of llamas to familiar and unfamiliar humans under housing and management conditions typical of both zoological gardens and llama farms. A group of five adult llamas was exposed to three 30-min socialization sessions with one female handler, who offered food and tactile contact. Subjects were then tested for their responses to the familiar handler (A) versus a stranger (B) in an A_1-B-A_2 design. Proximity to the handler, sampled at 5-sec intervals through the 1-min test exposures, was used as a dependent variable. For both the A_1-B and B-A_2 comparisons, the number of animals present in the test area was significantly lower in the presence of the unfamiliar human ($p < 0.001$; 2-tailed Randomization Test). This finding has important implications for llama housing and management, where individual humans may serve as discrete conditioned or discriminative stimuli if repeatedly paired with hedonic events. Such human-based conditioning may affect animal behavior, physiology, and motivation. Interactions with humans may thus potentially confound experimental results in a research environment, or be used to facilitate management or training.

The llama (*Lama glama*) and its smaller relatives, the alpaca and vicuña, have been domesticated for nearly 5,000 years. Traditionally prized in Peru for their meat and as beasts of burden, llamas were first reintroduced to the United States in the late 1800s. Until recently, North American llamas have been housed principally in zoological gardens or exotic animal farms. Since the 1970s, llamas have been increasingly kept in Canada and the United States as pack animals, flock guardians, and companion animals.

The llama's usefulness as a work or companion animal depends on the success of close contact with humans. Whereas the effects of human-animal interactions on the human participants are typically well documented (e.g., Boldt and Dellman-Jenkins, 1992; Loughlin and Dowrick, 1993), the impact on the animals has been largely overlooked.

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Nevertheless, it is hard to imagine that animals are unaffected by repeated interactions with humans. Whether positive or negative, these effects may have important implications for animal use in a variety of contexts. They may confound experimental results (Davis and Balfour, 1992) or be used to facilitate management or training (Pepperberg, 1992; Reinhardt, 1992).

Such human-based behavioral or motivational effects have a solid theoretical grounding in the psychological literature. Pavlov (1927) described the inevitable results of an animal's interactions with a scientist as a "socialization reflex". Because human caretakers or experimenters are frequently associated with hedonic stimuli (e.g., food, pain), they readily come to predict the arrival of such events (Morton, 1990). Gantt, Newton, Foyer, and Stevens (1966) have documented and described this process in terms of "Person as CS" (Conditioned Stimulus). Human-animal interactions may also be understood in terms of operant conditioning. For example, Taylor and Davis (in press) have reported evidence of cattle using individual humans as discriminative stimuli for positively reinforced operant responding. Whether scientist-animal interactions are described in Pavlovian or operant terms, the fact remains that their effects are directly measurable. Indeed, Davis and Balfour (1992) provided wide-ranging evidence of the impact of interactions with humans on the behavior and physiology of animal subjects.

The implicit assumption underlying such observations is that animals can discriminate between individual humans in their environment. To date, evidence of human discrimination by animals is primarily based on anecdotal reports by pet owners, zookeepers, and livestock managers, and is intuitively confined to so-called "higher animals" (e.g., Hediger, 1964 pp. 162-163). Although there is little empirical evidence for this ability in any species, there are some exceptions. Slobodchikoff, Kiriazis, Fischer, and Creef (1991) report that prairie dogs emit alarm calls that are specific to individual human predators. Evidence suggesting human recognition has also been reported in dogs (Settle, Sommerville, McCormick, and Broom, 1994), chimpanzees (Boysen and Berntson, 1986), sea lions (Schusterman, Gisiner, and Hanggi, 1992), pigs (Tanida, Miura, Tanaka, and Yoshimoto, 1995), and rats (Davis, Taylor, and Norris, 1977).

Despite their long history of domestication and service to humans world-wide, llamas have been the subject of very little behavioral research. Although excellent training manuals and field reports of wild camelids exist, there appears to be no systematic information on the mechanisms underlying lamoid social behavior (e.g., Hoffman and Asmus, 1989; McGee and Tellington-Jones, 1992; Vilá, 1992).

Anecdotal reports suggest that llamas are curious, yet aloof, animals (Brillig Hill, Inc., 1995). Further, they appear shy and resent close physical contact with strangers (Franklin, 1984; McGee, 1994). Llamas are reported to recognize their regular caretakers or trainers (even after a period of separation), and to visually track known humans in a group of strangers (B. Russell, personal communication). To date, however, human-llama interactions have not been the subject of systematic research. Thus, the current study seeks to explore the response of llamas to familiar and unfamiliar humans under housing and management conditions typical of both zoological gardens and llama farms.

METHOD

Subjects

Five llamas (4 females and 1 male), ranging in age from 1 to 5 years served as subjects. The animals were housed in an L-shaped outdoor enclosure measuring approximately 9m by 9m (Figure 1). Subjects were fed a maintenance ration of mixed hay and ruminant cubes.

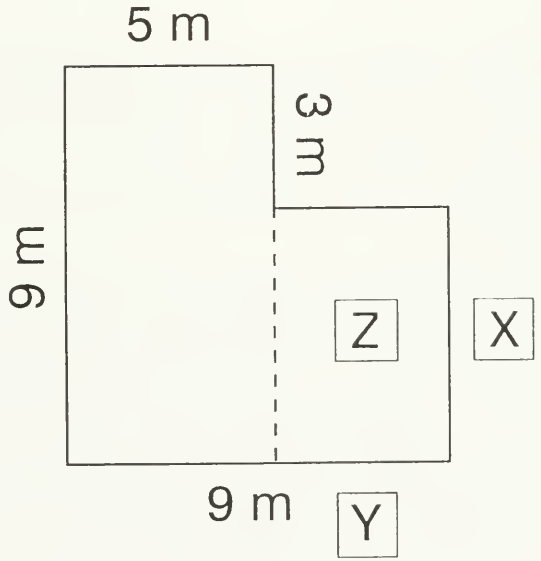

Figure 1. The experimental enclosure. X represents the location of the handler, Y is the location from which the test sessions were videotaped, and Z is the test area.

Procedure

Subjects were exposed to one female handler (AAT: Caucasian, 1.8 m) for three 30-min socialization sessions on successive days. The subjects had never seen this handler prior to the initial socialization session. During these sessions, the handler stood outside the enclosure at location X (Figure 1) and offered food rewards of ruminant cubes to animals who approached. Subjects who initiated physical contact with the handler were stroked gently on the neck. The handler spoke quietly to the animals throughout the socialization sessions.

On the fourth day, subjects were tested for their responses to the familiar handler versus a female stranger (Caucasian, 1.65 m). The test sessions consisted of successive 1-min exposures to the familiar handler (A) and the stranger (B) in an A_1-B-A_2 design. Exposures were separated by approximately 15 min. A test was not started until all animals were outside of area Z (Figure 1). To initiate a test exposure, the handler emerged from the adjoining barn and walked quietly to location X, where she stood motionless with empty hands outstretched (palms up) and resting on the top rail of the fence. All test sessions were videotaped from location Y.

Data Analysis

Preliminary observations revealed that physical contact with the handler was frequently affected by the social hierarchy within the group. The dominant animal would typically position itself close to the handler, effectively preventing the other animals from approaching. Thus, individual animal latency to contact the handler proved an ineffective dependent variable.

Instead, proximity was used as a behavioral indicator of recognition. At 5-sec intervals throughout the 1 min test exposures, the number of animals present in the test area was counted (see Figure 1, area Z).

The Randomization Test for matched pairs (Seigel, 1956) was used to evaluate the number of animals in the test area in the presence of the two humans. The Randomization Test was performed twice: once to compare the A_1 and B exposures; and then to compare the B and A_2 exposures. In each case, the numbers of animals present in area Z at each 5-sec interval were paired for comparison.

RESULTS

Table 1 reports the average number of llamas in the test area during exposure to the familiar and unfamiliar humans. These data suggest a general decline in the number of animals in the presence of the unfamiliar human. A statistical comparison of these data for each 5-sec interval of the 1-min test exposure confirms a significant difference in the llamas' response to the familiar and unfamiliar humans in both A_1-B and B-A_2 comparisons ($p \leq 0.001$; 2-tailed Randomization test, Seigel, 1956).

Table 1. Number of llamas (maximum = 5) in the test area in the presence of familiar and unfamiliar humans during 1-min test sessions (average of 12 5-sec sampling intervals).

	Mean number llamas present per 5-sec interval
A_1 - Familiar	3.00
B - Unfamiliar	0.58
A_2 - Familiar	2.60

DISCUSSION

Our results support anecdotal reports that llamas can discriminate familiar from unfamiliar humans. Further, they manifest this discrimination by avoiding the unfamiliar handler (relative to the familiar handler) in an open-field test situation. This "avoidance" may, in fact reflect one, or both, of two distinct motivational mechanisms: a specific aversion to the unfamiliar handler (neophobia), or a relative lack of motivation to approach a handler who was never previously paired with positive hedonic stimuli. Given previous descriptions of the llama's wary nature (Franklin, 1984; McGee, 1994), an explanation in terms of neophobia seems most likely. In the present case, however, it should be stressed that "familiarity" with Handler A was facilitated by food, positive tactile stimuli, and a lack of threatening behavior. Whether such motivation is essentially appetitive or aversive (or, for that matter, reflects operant or Pavlovian conditioning), the fact remains that llamas readily discriminate between human handlers.

Our data do not allow us to identify the sensory modality used by llamas to make this discrimination. Given the distance (approximately 4 m) at which recognition was expressed, it appears likely that vision, rather than olfaction, was employed (B. Russell, personal

communication). However, this conclusion is far from definitive. Virtually nothing appears to be known about the relative dominance of visual, olfactory, and auditory mechanisms in llama social behavior in general, or conspecific (or other) recognition in particular.

The finding that llamas can discriminate individual humans has important implications for their housing and management, both in zoological gardens and as companion animals. Once individual humans have been identified, they may serve as discrete conditioned stimuli (CSs) if repeatedly paired with the hedonic events that are fundamental to zoo or farm life. Such human-based Pavlovian conditioning may interfere with routine care and management if changes in personnel occur (e.g., weekend staff). In addition, llamas may be expected to distinguish humans who have performed aversive procedures in the past, making future interactions more difficult if appropriate training and/or desensitization is not performed.

On the other hand, positive human-animal interactions may be used to facilitate the management and training of llamas (McGee, 1994). Indeed, other species have been motivated to perform both simple and complex tasks as a result of close relationships with individual handlers (e.g. Boysen, 1992; Davis and Perusse, 1988; Pepperberg, 1992). Alternatively, animals have been trained to tolerate and willingly participate in potentially aversive management routines through the use of positive interactions with specific humans (e.g., Reinhardt, 1992).

Regardless of the nature of their effects, it is clear that repeated interactions with humans can have direct implications for animal behavior, physiology, and motivation (Davis and Balfour, 1992). Our findings confirm anecdotal evidence that llamas can discriminate individual humans, and that they respond negatively to the presence of strangers. Such human-based effects should be considered when designing research protocols, scheduling personnel, and developing management and training programs for llamas.

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