CHAPTER FOURTEEN

Reinforcement Training as Interspecies Communication

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Dolphin domestication

Most of the large mammals that are trained to perform useful work for man, whether horse or dog, camel or yak, were brought into captivity and successfully domesticated by the dawn of recorded history. The dolphin, therefore, is a very recent addition to the roster of man's animal partners. We may think of dolphins primarily as performers, like circus animals. However, beginning in the early 1960s, dolphins have also become established as at least semi-domesticated animals, capable of performing useful tasks in their natural environment, the ocean. For example, at the United States Naval Ocean Systems Centers in San Diego and in Hawaii, dolphins have been trained to carry burdens and (as have sea lions) to seek, locate, and aid in the recovery of underwater objects.

Dolphins differ, however, from horses, dogs, and most other domestic animals, not only in being aquatic but in the methods by which they are trained. The training of behavior in terrestrial

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domestic animals is almost always accomplished by means of negative reinforcement, coercion, and restraint; and it is enforced with punishment. The ox moves forward to avoid the goad, and thus pulls the wagon. The dog must obey the leash, the horse the bridle. The sheep which will not move with the other sheep will be barked at or even bitten by the dog, and the dog which does not chase sheep when told to will be beaten by the shepherd. The dolphin, however, is not easily trained by these negative methods. The dolphin thus has become one of the few large mammals with which we have had extensive experience in the shaping of behavior primarily, and indeed in most cases almost exclusively, by the use of positive reinforcement.

Although a few dolphins were kept as aquarium specimens as early as the 1860s, routine maintenance of dolphins in captivity first occurred just before World War II (for a history of dolphins in captivity, see Defran & Pryor, 1980.) Thus techniques for the maintenance and training of dolphins were being developed during roughly the same decades in which experimental psychologists were reaching an understanding of the laws of operant conditioning, and the ways in which behavior could be modified by using positive reinforcement—the area of research associated most prominently with B. F. Skinner.

Several behavioral psychologists, students or colleagues of Skinner, were closely involved with the development of dolphin training techniques in the early decades of dolphin use and research. Keller Breland, under the auspices of a visionary Naval research director, William B. McLean, was instrumental in the development of the Navy's dolphin research programs and in the uses of operant techniques for both basic and applied research with dolphins by Navy scientists. R. N. Turner, working with Kenneth Norris at Marineland of the Pacific, developed reinforcement training techniques for some of the first dolphin sonar research, and was the original source of operant conditioning techniques for innovative work at Sea Life Park and the Oceanic Institute in the 1960s. Kent Burgess provided a sound scientific grounding for the training program at Sea World

during its early years. Many contributions to methodology have since been made by trainers at these and other organizations (Schusterman, 1980; Turner, 1964).

Positive reinforcement training and cognition

In traditional force-training of domestic animals, the subject typically is not given choices (other than the implied choice, "Obey, or else!") For example if one asks a horse pulling a wagon to turn left, one wants only that behavior, and no other: not a right turn or an increase in speed, and certainly not some self-initiated behavior such as standing on the hind legs or jumping in the air. However the training of dolphins by positive reinforcement techniques often gives the animal freedom to demonstrate whatever capabilities it may have. During the training process the animal is at liberty to initiate its own behavior, as well as interactions with the trainer, in a way that is almost impossible in the restrictive circumstances of traditional training of domestic animals (or, for that matter, in the "whip-and-chair" aversive training traditionally used with circus animals.) To a certain extent it is this circumstance, rather than some intrinsic characteristic of the dolphin, which has given the public and scientists alike such respect for the animal's cognitive abilities: We get more chances to observe cognitive processes in these animals than in most others.

Reinforcement training is interactive: What the trainer does depends on what the animal does. The trainer can, and often does, develop behavior without making any attempt to prompt or cue the animal, but instead by watching, reacting, and reinforcing behavior that does occur. Thus the animal discovers that various actions of its own may result in reinforcement. One might say that as the trainer is developing behavior, the animal in effect is training the trainer to give fish.

Opportunity is thus provided for an animal to utilize cognitive skills. A well-known example is the much-anthologized "creative porpoise" experiment at Sea Life Park in which a rough-toothed dolphin *(Steno bredanensis)* was taught to respond to the criterion "Only behavior which has not previously been rewarded will

now be reinforced." In each training session a behavior was selected for reinforcement which had not previously been a conditioned behavior. Within a few such sessions, the normal behavioral repertoire was exhausted. After a period of confusion, the animal began offering novel behaviors such as aerial flips, spitting, and swimming in corkscrew patterns, thus fulfilling the criterion—and demonstrating a capacity not only for complex learning but also for a certain amount of creativity (Pryor, Haag, & O'Reilly, 1969).

Another example of insightful behavior is the ability of some experienced animals to "check out" training criteria by running through a series of variations on a learned behavior. A false killer whale *(Pseudorca crassidens)* at Sea Life Park did this when trainers attempted to correct an error in a routine in the performance. Two whales had been trained to jump over a hurdle simultaneously in opposite directions; however one whale had taken to jumping late. When the trainers held a practice session and did not reinforce the late jumper, it "tested the premise" by a series of five jumps: (1) it made a perfect jump and was reinforced; (2) it made a late jump and was not reinforced; (3) it made a perfectly timed jump, but from the wrong side, traveling parallel to the other whale rather than in the opposite direction, an unprecedented event for which it had never been reinforced; (4) it made a correct jump that was just a little bit late, and received a very small reinforcement; and, finally, (5) it made a correct jump that was also perfectly timed, received a large number of fish, and performed correctly from then on (Pryor, 1981b).

Another not uncommon example of cognitive activity in trained dolphins is the deliberate wrong response. Ronald Schusterman has described an experiment in which a bottlenose dolphin *(Tursiops truncatus)* was being asked to make a series of choices, and after many correct responses, one day made a long series of completely wrong responses. The animal was being reinforced by fish dispensed from a feeding machine; examination revealed that the fish in the machine had dried out and become unpalatable. When the fish were replaced, the

dolphin resumed making correct responses (Schusterman, personal communication).

Within the context of a positive reinforcement training session it is not just dolphins that can use the rules of the game to "train the trainer." During a project at the National Zoological Park in which I taught reinforcement training to a group of keepers (Pryor, 1981a), primate caretaker Melanie Bond was using food reinforcement to shape behavior in a chimpanzee. When the session was over, she moved to open the door and let the chimpanzee into its outside run, whereupon the animal reinforced this desirable behavior by handing her a piece of celery. During the same project, I was training a juvenile elephant to retrieve objects tossed into its pen. In the first session, the elephant quickly trained me to give it only the preferred reinforcement, sweet potatoes, from an assortment of food. When that was successful, it used the same methods—eye glances and trunk movements, primarily—to try to get me to unlock the cage door. I have seen similar grasping of both concept and opportunity in a wolf (Pryor, 1984). It is perhaps worth noting that this kind of event occurs frequently only in the training of those species which are commonly thought to be the most "intelligent," such as apes, dolphins, elephants, and some parrots.

Because these kinds of events take place within a training situation, they are often amenable to replication (the "creative porpoise" experiment described above was a replication of a serendipitous event that occurred during public performances.) Thus reinforcement training constitutes an excellent tool for the investigation of animal cognition.

Reinforcement training and intraspecific signals

Another consequence of reinforcement training is that the animal may—in fact almost invariably does—direct its own intraspecific social signals at the trainer. Reinforcement training thus becomes a marvelous tool for the ethologist. Suppose one is looking at a tankful of dolphins, and a single animal leaps into the air and comes down sideways, a behavior known as breaching. In a tank of captive dolphins, one might be able to speculate about why the animal breached, based on past

observations and the concurrent behavior of the other dolphins; but a great many observations might be needed to speculate correctly. Also, since breaching in dolphins appears to have several functions, from removal of remoras to driving of prey to various kinds of social signals, it might also take long observation to be able to state with some confidence what the function of a particular breach might be in a particular circumstance. Suppose, however, that I am engaged in a training session with a dolphin, shaping some particular behavior, and, either accidentally or deliberately, I fail to reinforce some action which previously has invariably resulted in the arrival of a fish. If the dolphin then leaps up in the air and comes down sidewise in such a way that it soaks me from head to toes—then I can say, from just that one experience, that at least in certain circumstances a breach is an aggressive or agonistic display, and a pretty good one, too.[2]

It is not just with dolphins that reinforcement training is a useful tool to the student of animal communication. While working at the National Zoo I saw several magnificent examples of animals directing intraspecific social displays to their keepers/trainers. Hyenas, for instance, are quite transformed by the throes of a greeting display: The tail goes in circles, the dorsal hair stands on end, the ears come up, the mouth opens with the tongue hanging out, and the animal makes an incredible variety of sounds, giving the effect (to portray the behavior with an anthropomorphic metaphor) of a person exclaiming, "My dear, where have you *been,* I haven't seen you in ages, you look *wonderful,* well don't just stand there come *in,* tell me what's happening!" I have seen a polar bear respond to a reinforcement during a training session by bouncing down on its elbows and offering its trainer, on the other side of the bars, a clear-cut play invitation: a piece of communication which one might not

[2]In this circumstance, familiar to most dolphin trainers, the training context not only illuminates the nature of the social signal, but also allows the signal to function as communication. For example, if the breaching animal is young or inexperienced, and especially if my failure to reinforce (thus putting the animal on an extinction schedule) was inadvertent, I would at once modify my own behavior and reinforce more liberally, in order to reduce the animal's distress lest it interfere with the progress of training.

expect to see in an adult of that species in a lifetime of watching. It is the context provided by the training situation that allows one to interpret behavior with considerable accuracy. As ethologist Konrad Lorenz has put it, one can use "the subtlety of conditioning not only as an end in itself... but as a tool to gain knowledge about the animal as a whole." (Lorenz, 1975.)

keinforcement training and human-animal communication

In this rich setting of mutual interaction and the mutual exchange of reinforcement (the animal's successful responses are the trainer's reinforcement) we can communicate a remarkably various and detailed set of information to the dolphin, as demonstrated by the performance of many research, display, and working animals all around the world. However the training context also gives the dolphins a fine opportunity to communicate with us, and thus to allow us fleeting but real glimpses of both the animal's state of affect and of cognitive processes in action. At Sea Life Park in Hawaii in about 1965 I was working with a newly captured rough-toothed dolphin, an unusual oceanic species about which little was then known. I was beginning to initiate this individual into the rules of the training game by teaching it a few ways to earn a reinforcement. The first step, teaching the animal to associate the sound of a whistle (a conditioned reinforcer) with the arrival of a fish (a primary reinforcer) had been accomplished. Now, as I watched at tankside, the animal happened to leap from the water. I blew the whistle, and tossed the animal a fish. Within a few minutes the animal was leaping repeatedly, earning one fish after another.

Then the animal happened to make a noise, a little squeak. Unlike many other species of dolphins, rough-toothed dolphins rarely make audible sounds, and I had never heard this individual make a noise before; curious to hear more, I reinforced the emission of the sound. The animal made the sound several times and I reinforced the noise-making several times. I was surprised and pleased that a newly captured animal with so little training experience could learn to repeat a new behavior so

readily.[3] Then the animal leaped again, and I made a training mistake. I was more interested in the unusual noise-making, now, than in leaping, which I felt sure I would have other opportunities to reinforce, as the animal did it often. So I did not respond to the leaping.

The animal became visibly upset. A very "green" animal, it had had no previous experience of failure to earn reinforcement in a training situation, and it rushed around the tank breaching and then went over to the far side of the tank and turned its back on me. "I don't want to play this game any more."

The next day the animal was swimming around the tank, and again it offered the leaping. Now a clarification of the rules was needed, a signal that would define when leaping would be reinforced. I raised my hand, to act as a cue, and reinforced leaping when my hand was up, but not when it was down, several times. In a few minutes the animal was exhibiting the correct behavior in the presence of the newly established cue (again, in my opinion, a rather impressive rate of learning in a novice subject).

Then the animal happened to make the noise again. I reinforced the noise, and immediately also lifted my hand so it would have the opportunity to get reinforced for leaping too, which it did. The animal then initiated and carried out the sequence of "noise, conditioned reinforcer, signal for leap, leap, and primary reinforcer" several times. It then swam to the other side of the tank, but without apparent agitation, so I took advantage of the pause in the proceedings to put my arms in the water and rinse the fish juice off my hands.

As I was doing this, the dolphin came over, and with one flipper stroked my arm up and down, very vigorously, an

[3]Usually, in reinforcing spontaneously occurring behavior in an inexperienced dolphin, one expects to have to reinforce the behavior several to many times, perhaps over a period of days, before the animal "realizes" what action is being reinforced, and offers the behavior repeatedly. Often one must condition two or three kinds of responses before the individual generalizes, i.e. becomes capable of immediately repeating any new response as soon as it is reinforced more than once. This animal had learned to offer not just one but two new behaviors, with high frequency, in its first real training session. At Sea Life Park we were to find that rough-toothed dolphins seem to be unusually good at acquiring and exhibiting such rule-governed behavior.

affiliative signal frequently seen between dolphins but never, in my experience, from dolphin to person. In this context it might be loosely interpreted as "Okay, stupid, I understand what you mean now, and you're forgiven" (Pryor, 1974).

This kind of event, a real communication, can be an emotional experience for man and beast alike. When this individual, Malia, later to become a rather well-known research and performance animal, rubbed my arm, I was touched, and dumped all the rest of the fish into the tank. However, this and all similar anecdotes are not so much an indication of some quasi-human capabilities of an animal or a species, or of the sentimentality of porpoise trainers, but of the enormous potential of interactive training as a window into animal behavior *and* potentially into animal consciousness.

Conclusion

Traditional animal training can also develop a situation of rapport and communication between trainer and subject. Traditional training, however, of dogs or horses, say, requires the patient acquisition of physical skills, sometimes at considerable risk. Just learning to ride a horse involves more time and physical effort than most people care to spend, and that is nothing compared to the physical skills and risks involved in training a horse. Thus the "glimpses through the window" afforded to the traditional animal trainer are not available to most people; and those who are both traditional trainers and convincing communicators are few.

Here, slightly paraphrased, is a statement from a professional writer who is also a trainer:

> "These are beautiful, marvelous creatures, whose responses and instincts work on a plane as different from humans as water and oil .... Insight into their senses and consciousness is like a half-opened door or a half-learned language; our comprehension is maddeningly balked by not having the right sorts of hearing, or sense of touch; or maybe good enough telepathy. The feeling of oneness I have sometimes had with them has been their gift to an inferior being; but maybe my passion to [find out what we can accomplish together] has been my gift to them." (Francis, 1976)

This paragraph was not written by a dolphin trainer, but by Dick Francis, a horse trainer and steeplechase jockey. The oneness he speaks of is the learned interaction of horse and rider in a race. It's a communication not available to many, and not particularly accessible to research. However, reinforcement training brings this particular window into the house of science. As the philosopher Gregory Bateson said, "Operant conditioning is a method of communication with an alien species" (Pryor, 1975). It is not merely a way of communicating our wishes to an animal, but a two-way system. It is, in fact, a game, rigorous in rules but admitting of spontaneity. We should not be misled by the effects of this system into thinking that dolphins are somehow more "intelligent" than they are, nor that all other animals are necessarily less. Instead we should perhaps give more serious attention to the possibilities of the training context as an investigative tool in the study of animal awareness and cognition.

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