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Author
Young, Robert J.

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Uncloaking the Magician: Contributions of Comparative Psychology to Understanding Animal Training

Robert J. Young
Pontifíca Universidade Católica de Minas Gerais, Brazil

The training of animals is an ancient anthropogenic process; however, it was not until the birth of comparative psychology, as a science, that the mysterious ways of the animal trainer were formally explained. In this review I will discuss the contributions of comparative psychology both past and present in animal training. The discoveries of comparative psychologists have greatly enhanced the animal training process and resulted in new methods for training animals; for example, training animals using social models. Despite, comparative psychology being a quantitative science we have still to empirically evaluate the animal training process. I therefore suggest how we might further our understanding of animal training and hence animal learning processes through the collection of data and meta-analyses.

Training in the circus world (as well as outside it) is surrounded with secrets, mystic and magic. Trainers seem almost frightened that their secrets will out...

Kiley-Worthington, 1990, p. 140.

In ancient societies animal trainers must have appeared to have had the skills of a magician. Imagine the awe people must have had for elephant trainers–people who had the "powers" to control such enormous animals. As indicated in the quote above animal trainers have surrounded their "powers" with mystery so as to maintain their personal importance in the society in which they lived. Clearly, we can see parallels between animal trainers and magicians–hence the title of this article. In this article I intend to look historically at the process of animal training, then look at recent developments, and finally identify future research directions.

In this article I use the term animal training to be synonymous with animal handling since both require the modification of animal behavior through learning processes. Furthermore, I will not discuss in detail the processes of animal learning (e.g., operant conditioning) since they are well known to the readership of this journal; however, I will provide a few everyday examples of animal training. Mainly, I intend to focus on how comparative psychology can not only explain, but also improve animal training.

Living in an Operant and Pavlovian World

Although, not appreciated by the majority of people, we live in an operant world. The most basic example of this is the receipt of a salary for doing work;

I am grateful to Melissa Burns for encouraging me to write this article, and to Daniel Mills for locating a number of useful references. Correspondence concerning this article may be addressed to Robert J. Young, Conservation, Ecology and Animal Behavior Group, Prédio 41, Mestrado em Zoologia, Pontifíca Universidade Católica de Minas Gerais, Av. Dom José Gaspar, 500, Coração Eucarístico, 30535-610, Belo Horizonte, Minas Gerais, Brasil (robyoung@pucminas.br).

that is, we emit behaviors (work) to obtain reinforcers (money). On a more fundamental level we use associative learning processes in our everyday social interactions. We praise our children for doing well at school and scold them for misbehaving. It would be fair to say that all humans are subject to the influence of reinforcement throughout their daily activities. More well known by the public is that we can train animals to do our bidding. All human societies know that animals can be motivated to do a human commanded behavior through the application of rewards and undesired behaviors can be stopped using punishment. However, few people can explain these processes in scientific terms and many people do not appreciate that the conditioning of behavior is constantly happening.

As an example, let us consider the dog that will not stop barking or the child that throws temper tantrums. Often if we investigate why these behaviors occur we find it is due to unconscious training on part of the dog owner or parent. For example, the dog may have been put in the garden and then barked to get the owner's attention. The owner, fearful of the neighbors complaining about the noise, lets the dog back in the house. If this process is repeated and the owner tries to wait until the dog stops barking but eventually lets the dog into the house while it is still barking. The dog has learnt to keep barking until it is allowed into the house (i.e., the persistent emission of behavior results in a reward, being reunited with the owner). Similarly, a child that throws a temper tantrum to get sweets is emitting a behavior to gain a reward. If the parents resolve not to "give in" to such temper tantrums but eventually do so (each time waiting more time before buying the child sweets), then the child is being conditioned to throw longer and more violent temper tantrums.

The active training of animals by humans can also result in the animals training the humans. A classic example being the training of dogs to do tricks. Often people that train their dogs to do tricks use continuous reinforcement to shape their dog's behavior. Dogs quickly learn that if they perform the trick without being requested to do so that they will receive a reward, now the dog has the owner trained anytime the dog wishes a reward it only needs to perform the trick.

Animals in human society also learn the signals that good or bad things might be about to happen. For example, a dog might learn that when the owner puts it in the garden during the dark that this is the signal that it will soon be put into a room on its own (i.e., put to bed). Many dogs do not like being alone and therefore become aggressive at this signal: they associate being let outside during the dark with the subsequent solitary confinement. It is therefore not surprising that some dog owners report that their dogs suddenly become aggressive at "bedtime," since this Pavlovian process has prepared the dog to be aggressive (see Chance, 1998).

I could continue with examples at ad infinitum because humans and animals are living in a world that as well as being controlled by the laws of physics is biologically also controlled by associative learning processes.

Animal Training: A Brief History

Undoubtedly, animal training is an ancient anthropogenic process that perhaps dates back to when humans first domesticated the wolf around 12,000 years ago (Davis & Valla, 1978), according to the archaeological record, or 135,000

years ago according to recent DNA analyses (Vilar et al., 1997). There exists documented evidence that humans were training elephants as vehicles of war as long as 4,500 years ago (Zeuner, 1963). Therefore the process of animal training is an ancient one in comparison with the scientific discipline of comparative psychology.

To understand the importance of animal training I think we need to look briefly at the importance of animal training to human societies (for an overview see Mason, 1984). There are perhaps no human societies that do not train and utilize the skills or properties of animals for their own benefits. Even in highly technology-based societies–the proper functioning of society would not be possible without trained animals. Take the example of air-travel, most international airports have "sniffer" dogs that look for weapons, explosives and drugs. In third-world societies, animals are not only sources of nutrients but also sources of power or transport; however, to utilize them for such purposes they need to be trained. Already, the uses of trained animals forms a long list and it seems to be continually increasing as we realize the potential of using animal training to tap into animals' sensory and physical capabilities for human benefit. Animal trainers have therefore come to prominence in many societies, and I believe will be of greater importance in the future as we find new ways in which to tap into the abilities of animals. One pertinent example is the use of trained pigeons to find people lost at sea: pigeons are trained to peck a key when they see a life jacket and these key pecks guide a helicopter pilot to the lost person.

Presently, virtually all animal trainers who have a background in science present themselves to be disciples of animal learning theory (e.g., Karen Pryor, Tim Desmond, Marian Breland, amongst others). It is probably true to say that until the arrival of research into animal learning by comparative psychologists, such as Edward Thorndike, Ivan Pavlov, James Watson, and Fredric Skinner, it would have been difficult to explain how the animal trainer's skills worked.

In 1888, George Romanes, a student of Darwin, published his collection of anecdotes about animal intelligence in a book called *Animal Intelligence*. In the late 1890s, Edward Thorndike, unhappy with the nonempirical approach of Romanes into studying animal cognition, conducted a series of experiments on animal intelligence for his doctorate. Later, these and other experiments would become the basis for his Laws of Effect, which were published in 1905. At the same period in time, Pavlov was publishing the results of his research on the conditioned reflex (1903); thus providing the knowledge and theoretical basis for the arrival of behaviorism, as introduced by John Watson in 1913. Although, most of the knowledge needed to explain how animal trainers did their "tricks" was now in place, it was not until the 1940s that Frederic Skinner and his students Marian and Keller Breland really started to use this knowledge to train animals.

In the 1940s, the Second World War motivated Skinner and his students to try and apply animal training to assist the war effort. In a series of experiments, Skinner and his coworkers were able to show that it was possible to train pigeons to guide a bomb to a predetermined target. Ultimately, this program of pigeon guided bombs was rejected in favor of developing electronic guidance systems but this example clearly displayed the novel uses to which animals could be put. After the war, the Brelands left Skinner's laboratory and setup a commercial animal training business–based on the knowledge they had gain from working with Skin-

ner–the results of which were published in their celebrated article *The Misbehavior of Organisms* (Breland & Breland, 1961). The difference between the Brelands and other animal trainers, at that time, was that they could explain in scientific terms how their training methods worked, opening the doors for the development of new training methods.

One large advance that was made by "scientific" animal trainers, such as the Brelands, in the 1950s and 1960s, was the employment of clicker training or as it was originally called, "click and treat" training. This method was developed for the training of marine mammals, such as dolphins, that could often be some distance away from their trainer when they had performed the commanded behavior, the consequence of which would be a long delay in the receipt of a positive reinforcer. Psychologists, training marine animals knew that the reinforcement must be given within seconds to an animal if it was to reinforce the correct behavior. Given the practical limitations under which they were working, they decided to associate in a Pavlovian fashion the delivery of the primary reinforcer with a click sound. Later comparative psychologists were able to show that this click had in itself reinforcing properties and it is now referred to in the psychological literature as a secondary reinforcer (Chance, 1998; Pryor, 1995). The development of the use of clicker training illustrates that comparative psychology was not just retrospectively explaining how animal training worked, but actively contributing to its development.

Historically, the most common method to train animals was the so-called "carrot and stick" method; that is, rewarding the animal for correct behavior (or more precisely commanded behavior) and punishing the animal for undesired behavior; this method perhaps dates back thousands of years (see Stevenson, 2002). However, research into animal learning by comparative psychologists has demonstrated that punishment is an ineffective way to train animals (Chance 1998; Pryor 1995). While punishment often does stop the expression of an undesired behavior, its effects are often short lived and the undesired behavior often quickly reappears. Despite this knowledge, the training of animals using punishment still persists today (see Monks of New Skete Staff, 2002; most national horse society training manuals suggest the use of punishment). Many modern manuals on training animals recommend the so-called "carrots and more carrots" method–the application of only positive reinforcement (Pryor, 1995). However, closer examination of these manuals shows that they usually recommend type II punishment–the ignoring of an animal when it does not perform the commanded behavior. Therefore, only punishment type I (i.e., physical punishment) has actually been abandoned in these manuals on animal training, thereby producing not only more effective and safer training methods (punished animals often become aggressive), but also more humane methods.

Origin of the "Carrot and Stick" Method

Studies into animal behavior have not always had a positive influence on animal training. Early studies into animal behavior tended to concentrate on how animals organize their social systems and many early papers reported that species lived in hierarchies that were maintained by aggression (Allee, 1938). These studies showed that the dominant individual gained control of the others in the group

through the emission of aggressive behavior toward subordinates (i.e., threats and attacks). Similarly, some studies by anthropologists and ethologists seemed to indicate that some pastoral peoples in Africa controlled their cattle by assuming the role of the alpha individual (Lott & Hart, 1977, 1979). Thus, the scene was set for animal trainers to apply such techniques with their animals (e.g., Grandin, 1981, with farm animals); this type of training, although it was principally punishment, was justified on the basis that it mimicked natural processes and therefore was not considered to cause animal welfare problems. Already, by this point in time, research into animal punishment had shown it to be largely ineffective as a method of training animals, as the undesired behaviors tended to reappear (see Chance, 1998). Perhaps the most well known example of using punishment during animal training was with pet dogs: Owners were recommended to dominate the dog as an alpha individual would do in the wild. Often dog trainers instructed owners in the use of the alpha roll; this was the turning of the dog onto its back and pinning it down by the throat (see, for example Monks of New Skete Staff, 2002). These domination techniques sometimes produced short-term improvements in training but most commonly resulted in an extreme aggressive response from the dog towards the owner. It was not just dogs that suffered. This line of aggressive animal training was also used with elephants (see Stevenson, 2002, for a review of literature) and has been suggested as a method of gaining cooperation from farm housed pigs (Grandin, 1981).

These methods were unsuccessful because they were based on punishment, and because many species of animals do not always respond to humans as if they were conspecifics (see Hemsworth & Barnett, 1987; Hemsworth & Gonyou, 1997). Thus, the reaction of the animal to human training was one of interspecies interaction and not intraspecies; this result would not have been a surprise to comparative psychologists who knew that animals could classify objects. For example, psychologists have shown that pigeons can classify objects into categories such as humans or not humans (Aust & Huber, 2001). Compounding the problem of using punishment was the fact that animal trainers tended to recommend the most severe form of alpha dominance–the alpha roll, for example, is normally used when one wolf is actually trying to kill another individual and not just to reprimand or dominate another individual (Mech, 1985). Fortunately, most animal trainers no longer recommend this method of dominating animals.

Modern dog trainers recommend that a dog can be dominated by controlling its access to food, toys, or sleeping sites (e.g., Pryor, 1985). It is interesting to reflect that, although early researchers knew that, through dominance, alpha individuals gained more access to resources, they apparently did not appreciate that this also meant dominant individuals also controlled access to resources. Thus, an animal could learn its position in the social hierarchy from its ability to control important resources in its environment. I suspect the explanation for this oversight is that control over resources is not so "eye-catching" as threats and physical aggression.

An animal living in an environment where access to resources are controlled is living in an environment full of opportunities to receive positive reinforcement (i.e., access to resources). Evolutionarily, it appears easier for punishment to evolve as a method for dominant animals to control subordinates. However, theoretical and experimental studies into animal behavior all demonstrate that

animals try to avoid aggressive encounters due to their high costs in terms of injuries and energy expenditure (Krebs & Davis, 1987). It is difficult to imagine how a system of intraspecific interactions could have evolved using positive or negative reinforcement because animals do not carry reinforcers with them. Or do they? Many social species of birds and mammals undertake social grooming whose function is not only to clean skin and feathers but also to increase the strength of social relationships (Dunbar, 1991). Grooming sessions are known to be pleasurable to animals, for example, horses and primates groom each other bodies in places where neuronal responses produce positive sensations (Feh & Mazieres, 1993; Keverne et al., 1989). Thus, the use of intraspecies positive reinforcement in the animal kingdom might be more widely spread than we have appreciated. Perhaps herein lies the reason why positive reinforcement is the most efficient way to train animals: it is the most natural method. So why then do animals use punishment type behaviors? Punishment is very effective for "here and now" situations. For example, a hungry alpha animal arrives at the site of some food being consumed by subordinates; the emission of aggressive behaviors to punish subordinates that try to feed will work immediately, whereas the use of positive reinforcement will not deter subordinates from feeding. In interpreting such behavior, we need to remember that while positive reinforcement might be most effective strategy to control the behavior of subordinates in the long term, most species do not have the ability to plan for the future (see Byrne, 1999). Thus, in an evolutionary sense and in intraspecific interactions, positive reinforcement can be used to modify the general way in which animals behave, whereas the use of punishment can control their behavior at a specific instance in time.

Punishment, therefore, is not recommended in animal training programs for four reasons: (1) its effects are short-lived; (2) animals can respond very aggressively to punishment; (3) animal welfare concerns (the application of punishment would be illegal in some countries); and (4) animals learn more effectively from positive reinforcement, therefore the use of punishment is a false economy.

Animal Whisperers: Return of the Magician

One present and publicly fashionable trend in animal training is the use of "animal whispering." In fact, animal whisperers have existed perhaps for hundreds of years (Kiley-Worthington, 1990). This name suggests that we have returned to an era when animal trainers were more magicians than technicians. Farmer-Dougan and Dougan (1999) studied the work of, perhaps, the world's most famous animal whisperer: Monty Roberts. In their analyses of his books, they showed that his approach to animal training was qualitative rather than quantitative–the methods he employed came directly from ethology, body language research, and behavioral analysis. However, their analyses also show that Monty Roberts, while extremely successful at applying these scientific processes, is relatively unaware of how they function and certainly does not explain them in scientific terms.

The title animal whisperer is an unfortunate one as it has also attracted individuals into animal training who do not understand the animal's signals or "body language" but instead believe that they can actually speak with the animals either directly or telepathically. This has distracted from the work of animal whisperers who do understand the body language of their animals and how they learn; these

animal whisperers, however, often still believe that they possess a "special gift" for training animals (see Farmer-Dougan & Dougan, 1999). Human society has often used mystical stories to explain poorly understood phenomena until a plausible and verifiable explanation appears–the classic case being the belief in a divine creator (see Hinde, 1999). Just as scientists have not been able to eradicate the belief in a divine creator through the study of evolution, not all people, including some animal trainers, believe that what they do can be explained by simple animal learning mechanisms.

New Tricks for the Magician: Cognition Experiments

Although, the idea of animal training is inextricably linked with the training of animals for applied purposes, it has also been used in investigations into animal cognition. The most famous experiments are perhaps those using sign language to communicate with chimpanzees (e.g., Gardner & Gardner, 1969). Some of the early experiments with sign language used simple associative learning to teach animals how to sign; for example, the work of Herb Terrace and his chimpanzee, Nim Chimpsky (Terrace, 1979). However, it was quickly realized that subjects trained by this method associated the making of signs with the gaining of food or other rewards, and not with the act of communication (beyond communicating their desire for a reward).

A number of scientists trying to solve the problem of how to communicate with animals, and thereby gain access to their mental processes, solved this problem by using social modeling protocols to train animals. Most famously Irene Pepperberg has used the social modeling theories of Todt (1975), Mowrer (1960), and Bandura (1971) to teach African Grey parrots to speak (Pepperberg, 1983). Her subjects learn through the gaining of intrinsic rewards and not extrinsic rewards such as food. Thus, for example, when one of her subjects learns to say the word "key" it receives the actual key as its reward (i.e., intrinsic) and not a food reward (i.e., extrinsic). In a recent experiment, McKinley and Young (2003) showed that this technique is equally effective as operant conditioning methods in training dogs to perform a selection-retrieval task. However, unlike Pepperberg, they did not go on to show that the dog understood the meaning of the object's name. McKinley and Young (2003) suggested that this method might be appropriate for training dogs that show aggression in the presence of food reinforcers.

In comparison with simple associative learning mechanisms, observational and social learning mechanisms appear to result in more rapid learning, in certain species, during a training process. These methods are perhaps more appropriate training techniques for certain applications. For example, in reintroduction training, an animal needs to learn the significance of what it has learned, not just that its behavior could result in positive reinforcement or punishment. Therefore, the use of such social learning mechanisms is likely to increase the effectiveness of animal training in such circumstances (Brown & Laland, 2001).

Performance Motivation: Using Positive Reinforcers

Modern comparative psychologists, unlike the founding fathers of their discipline, know that food is not just energy. Reading modern textbooks on behav-

ioral ecology, ethology, or animal behavior, one is given the distinct impression that food only equals energy and that energy is the most important characteristic of food (see Krebs & Davis, 1987). Perhaps this line of thinking came from laboratory experiments that fed animals complete diets or used only one food type. Nutritionists, of course, know that food is a complex combination of energy, protein, fats, vitamins, and minerals, all of which are important to animals. The importance of these nutrition characteristics varies between species and, therefore, different food sources will have different reinforcing properties.

The value of a food item as a reinforcer varies with the physical, physiological, and behavioral characterisitics of species. Take the case of primates. As body size increases from the pygmy marmoset (0.1 kg) to the gorilla (200 kg) the metabolic demands for energy decrease and we see in nature the diet changing from energy and protein rich (i.e., mainly insects and gum) to nutrient poor (i.e., mainly leaves; Richard, 1985). Therefore, while a lettuce leaf would have some reinforcing properties for a gorilla, it is unlikely to be a strong reinforcer for a marmoset. Furthermore, in species that ferment their food within their digestive tract, the release of nutrients may be slow and this will influence the reinforcing properties of the primary reinforcer. For example, it has been shown that it is difficult for sheep to learn operant tasks in a Skinner box (Jackson et al., 1999). Personally, I have found that for species whose digestive system does not process food rapidly (e.g., giraffes and rhinos), reinforcers such as being stroked are stronger reinforcers than food.

Stress and Distress

Factors influencing animal learning are varied but one factor shown to disrupt learning and memory is stress (Sapolsky, 1996). Studies on laboratory animals exposed to high levels of stress show that their performance in tests of learning and memory decrease dramatically. For example, domestic pigs exposed to stress find it difficult to relocate previously visited food sources (Mendl et al., 1997). The implication for animal trainers is that animals should only be trained under nonstressful conditions, if a high rate of success is to be achieved. Intuitively, most good animal trainers know this and ensure that the training environment is as stress free as possible.

Who's Training Who?

One of the perhaps most overlooked aspect of animal training is "who is training who." I once saw a wonderful cartoon of two rats in a Skinner box, one rat says to the other one: "Every time I press this button the scientist is conditioned to give me food." Animal training can be a two-way process, although few animal trainers recognize this possibility. Pryor (1995) has described how dolphins attempt to make their trainers fall into the pool by shaping them to reach out further and further with a target (basically the dolphins stop a few centimeters short of touching the target so the trainer leans over to assist them). Personally, I have seen great apes that similarly shape their trainers until the trainer comes within grabbing range. One further well known example, is an elephant that performs an exaggerated stereotypic behavior when its "favorite" trainer tries to walked away from it,

causing the trainer to return and thereby reinforce the animal. Two things cause the problem: (1) the animal trainers consider themselves to be incharge; and (2) animal trainers often naively believe that the animals they train are their friends.

Quantifying the Mystery

It is a surprising realization that the early comparative psychologists who turned to a career in animal training did not use their skills for quantifying animal behavior for quantifying the training process. There are a great number of successful animal training programs around the world but still relatively little data about animal training. Most of the publications about animal training are "How to train" or "Our experience of training" articles. Thus, despite the quantitative nature of comparative psychology, most of the data available on animal training are qualitative. Therefore, I propose that we should start to quantify the animal training process.

The kinds of variables we could record for each training session are: (1) the species (classifying them also according to Eisenberg's, 1981, categories of feeding); (2) age of the animal (in weeks plus status, infant, adult, etc); (3) animal rearing history (e.g., hand or mother reared); (4) group social composition (e.g., male-female ratio); (5) length of training session; (6) number of reinforcers given (both primary and secondary); (7) type of reinforcer given (e.g., food item); (8) schedule of reinforcement used (e.g., continuous or variable ratio, if variable, rate of reward); (9) behaviors trained (including time allocated to each behavior); (10) estimated percentage of compliance with behaviors commanded; (11) number of time outs used, why used, and on which behaviors; (12) data and time of training; (13) the number of the training session (e.g., 7^{th}); (14) the sex of the trainer; (15) weeks of experience of training animals by the trainer; (16) number of trainers present and number of animals present (can animals see other animals being trained?); (17) identity number for each trainer; (18) type of training environment (i.e., size, indoors, etc); (19) time interval between commanded behavior and its performance; and (20) time interval between the end of the commanded behavior and its reinforcement with food and/or clicker.

Obviously, to collect such data, a behavioral observer needs to work alongside the animal trainer, recording the aforementioned variables (using animal focal sampling and continuous recording of the trainer and the animal; see Martin & Bateson, 1993). Subsequently, the data could be typed into a computer program for analysis. However, much data would be needed before the effects of each component of a training program could be analyzed. Multiple stepwise regression would be one way to analyze such data to determine which factors are most important in the animal learning process. For each species and each variable measured, we would need data on a minimum of twenty individuals and, ideally, data that commenced with untrained animals and finished with fully trained animals. Therefore, in the scheme that I propose, we would need data on 20 (variables) x 20 (replications) that is 400 individuals. Obviously, for many species of exotic animals it would not be possible to obtain this quantity of data; however, for laboratory and zoo-housed chimpanzees, at least, it would be theoretically possible. The pooling of data from different institutions, if they use the same recording methods, could be employed to increase sample size. Another possibility is to reduce the number

of variables and thereby reduce the number of animal replicates needed. Although more viable, the risk of losing important information would be present.

The availability of such animal training data would demystify the animal training process by identifying which variables are most important in the success of an animal training program. More excitingly from a comparative psychology perspective, if such data became available on a wide range of species we would be able to perform meta-analysis of animal learning across a broad range of species, thus permitting the identification of across-species differences and similarities in animal learning (e.g., carnivores vs. herbivores). It would be possible to use the comparative method (Krebs & Davis, 1987; Martins, 1996; Timberlake, 1993) to examine the effects of many factors on animal learning (e.g., the effect of neocortex size).

Discussion

While comparative psychology has certainly uncloaked the magician (animal trainer), it has not, I believe, removed the wonder of his work and certainly not rendered his profession dead. Instead, the insights that comparative psychology has given us about animal learning have opened new possibilities for training animals in more effective ways. Furthermore, given that the sensory and physical abilities of animals are often beyond those of humans or the machines that humans can presently construct, I believe new and important roles will be found for trained animals to assist human society. For example, many psychologists and other scientists are concerned with producing robots that can act intelligently in complex environments. Software solutions to such problems have produced limited success. Presently, a number of scientists are trying to train robots to perform complex tasks through the use of clicker training (e.g., Kaplan et al., 2002); it remains to be seen if this approach will be successful. Therefore, I believe the discoveries of comparative psychologists in terms of animal learning, cognition, and sensory capabilities will grow in importance in the area of application. Furthermore, comparative psychology through its rigorous application of the scientific method has been able to explain all types of animal training, including those that initially appear beyond scientific explanation (e.g., animal whisperers).

To fully achieve its potential in terms of application, comparative psychology needs to start systematically investigating the animal training process–from which new insights into animal learning mechanisms may also emerge. Rather than regarding animal training as an unscientific by-product of research into comparative psychology, we should embrace its potential to further illuminate the capabilities of animals. Unfortunately, I think we may have to accept that experiments on animal training will not be possible, but the approach I have suggested of collecting data about actual animal training and then using meta-analysis would be productive. The main obstacle we face is convincing trainers to use the same methodology to record their training sessions and then to submit their data to a third party for analyses.

My central object in this work is to discuss the relation of the psychology of man to that of the higher Animals, since such a discussion forms in my opinion the best introduction to Comparative Psychology.

C. Lloyd Morgan, 1903, Preface.

A number of animal trainers have recently written books about their animal training methods so that they may be applied to humans (e.g., Pryor, 1995; Blanchard et al., 2002); thus, in the hundred years since Lloyd Morgan wrote the above sentence, comparative psychology really has come full circle.

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