Integrated clinical animal behavior

Clive D. L. Wynne[1]

Arizona State University

Short title:

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Summary

In this paper I outline the drawbacks with the two main behavioral approaches to animal behavior problems and argue that each alone is insufficient to underpin a field of clinical animal behavior. Applied ethology offers an interest in an animal's spontaneous behavior in natural contexts, understood within an ecological and evolutionary context, but lacks an awareness of mechanisms that can be manipulated to modify the behavior of individual animals. Behaviorism in the form of Applied Behavior Analysis offers a toolkit of techniques for modifying the behavior of individual animals, but has seldom been applied to non-human species, and often overlooks phylogenetic aspects of behavior. Notwithstanding the historical animosities between the two fields of animal behavior they are philosophically highly compatible – both being empiricist schools stemming ultimately from Darwin's insights. Though each individually is incomplete, I argue that an integrated approach that synthesizes the strengths of each holds great promise in helping the many animals who need our assistance to survive and thrive in human-dominated environments.

Keywords

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[1] Email: clivewynne@gmail.com

Introduction

There has never really been such a thing as 'Clinical Ethology' – and perhaps there never could be. Rather, I argue in this paper, if we are to help animals that find themselves in behavioral difficulty, what is needed is an integrated approach to animal behavior problems that profits from the best insights of the research traditions not just of ethologists but also of other forms of animal behavior scientist, such as behavior analysts. I call this approach Integrated Clinical Animal Behavior: ICAB.

I will argue here that both of the two rival schools of animal behavior studies: Ethology and Behaviorism are limited such that neither alone can provide animals with the support they need when problem behaviors arise. However, both also offer powerful insights which – notwithstanding the long history of animosity between some practitioners of the two schools – can be profitably combined into a modern integrated approach which has tremendous potential to improve the lives of animals. There are other approaches to animal behavior, including animal cognition (e.g., Wynne & Udell, 2020), and other approaches to treatment for behavioral problems, including particularly the medical approach, drawing on human psychiatry and informed by neurobiology (e.g., Overall, 2013). Neither of these will be covered except in passing in this paper. Animal Cognition, though it has greatly deepened our understanding of the full richness of animal behavior, has not to this point contributed in any significant way to the treatment of animal behavior problems. The medical approach to behavioral problems is constrained by its conceptualization of problem behaviors as pathologies, and a reductive pursuit of biomarkers and pharmaceutical treatments. As Mills (2017) has argued persuasively, the idea that normal and abnormal behavior are governed by different underlying process likely does not reflect the underlying biological reality.

Most commentators define ethology as an approach to the study of animal behavior, founded by Niko Tinbergen and Konrad Lorenz in the middle years of the twentieth century, that emphasizes the behavior of intact animals (Lorenz, 1981; Alcock, 2013; Dugatkin, 2020). Much of the field's early focus was on the

behavior of animals in their natural habitats (though Lorenz maintained that hand-reared animals could also be studied fruitfully: Lorenz, 1981). Observation of spontaneous behavior was a legitimate form of enquiry - though experimental manipulation was not ruled out. There was and continues to be an emphasis on the diversity of behavior observed in varied species and the commonality of behavior within a species. This focus on patterns of behavior as a species-typical characteristic was connected with an emphasis on what was known as instinctive or innate behavior. Over time, this insistence on the genetic underpinnings of behavior became softened into talk of 'Species typical' behavior (Dugatkin, 2020).

In a famous and still frequently-cited paper published to honor Lorenz's sixtieth birthday, Tinbergen (1963) commented on the diverse definitions of Ethology, "I have heard ethology characterized as the study of releasers, as the science of imprinting, as the science of innate behaviour; some say it is the activities of animal lovers; still others see it as the study of animals in their natural surroundings." (p. 410). He continued, "…I have become increasingly convinced that the fairest characterisation of Ethology is '*the biological study of behaviour*'. By this I mean that the science is characterised by an observable phenomenon (behaviour, or movement), and by a type of approach, a method of study (the biological method). … The biological method is characterised by the general scientific method, and in addition by the kind of questions we ask, which are the same throughout Biology and some of which are peculiar to it." (p. 411. Emphasis in original).

Tinbergen (1963) went on, after emphasizing the primacy of observation to the ethological project, to lay out the four kinds of causes that ethologists should seek for behavior. As is well-known, two of these are distal (evolution and phylogeny) and two are more proximate (mechanism – meaning physiological function - and ontogeny). Hogan (2009) has pointed out that studies of the mechanisms for animal behavior have proliferated – but largely outside of the hallways of ethology. On the one hand, Hogan makes the point that there has been a switch in interest in the field of ethology away from the questions of mechanism (which, I

will argue, are the kinds of questions that might have led to a clinical ethology) and towards more emphasis on ultimate notions of causation – Tinbergen's functional and evolutionary explanations. Hogan presents an analysis of papers published in *Animal Behaviour* every decade from 1963 through 2003. In this period there is an almost complete switch from over 90% of papers analyzing questions of (proximate) causation in 1963 to over 80% of papers investigating function (ultimate causation) in 2003.

There was little in the original formulation of ethology that offered itself to the development of a clinical science – it was not even clear what, within an ethological approach to animal behavior, might be considered a behavioral 'problem' for a clinician to work on. According to Tinbergen, Lorenz, and their followers, animals in nature live their lives and fulfil their biological destinies. Some have behavior better adapted to current conditions than others and consequently leave more offspring in the next generation – but there would appear to be no role for a clinician of animal behavior because there is little sense in which the behavior of an individual animal can be viewed as a problem. The chosen modes of understanding the causation of behavior also do not offer means for modifying behavior.

Given ethology's theoretical framework for understanding behavior it is consequently unsurprising that ethology has put relatively little emphasis on changing an individual's behavior.

One minor exception can be mentioned in passing. When he accepted the Nobel prize for medicine or physiology in 1974, Tinbergen gave speech in which he proposed that ethology could be the utilized in treatment of human 'stress diseases' (Tinbergen, 1974). He identified two domains: autism and correct posture. Regarding posture he advocated for the Alexander technique – which will not receive further comment here. In regards to autism, Tinbergen argued that the ethological approach of careful non-interventionist observation had led him to the conclusion that autistic children needed to be reached with much less intense social contact, and he offered anecdotes where he believed this approach had led to success. According to Tinbergen's biographer Kruuk (2004) this foray into

human clinical domain was met mainly by an embarrassed silence from his peers and collaborators.

Applied Ethology

The first steps towards deployment of ethological principles in the furtherance of animal welfare took place with the formation of what would become the International Society for Applied Ethology (ISAE). This was founded as the Society for Veterinary Ethology by a small core of Scottish veterinarians in 1966. The group quickly grew beyond Scotland and also rapidly found members outside the veterinary profession. Much of the early emphasis of the ISAE was on the behavioral welfare of farm animals (Newberry & Sandilands, 2016; Petherick & Duncan, 2016). The journal *Applied Animal Ethology*, (now *Applied Animal Behavior Science*) was founded in 1974 independently of the ISAE but quickly evolved a close association with the society which continues to this day. The journal focuses on papers concerning the behavior of farm animals or wild animals that impinge on farming or ranching by causing losses to operations; animals in captivity (such as in zoos and wildlife parks) and also considers papers on animals involved in hunting and recreation "in some instances" as well as the behavioral welfare of laboratory animals (Applied Animal Behavior Science: https://www.journals.elsevier.com/applied-animal-behaviour-science). A bibliometric analysis of trends in the scientific literature on animal welfare science over the fifty years from 1968 to 2017 found that farm animals dominate, with a small minority of papers on issues in conservation and sustainability (Freire & Nicol, 2019).

Applied ethology has been built on three approaches.

The first is the revealed preference test as a means of assessing animal (especially farm animal) welfare. "Applied ethologists try to put animals into situations where they can reveal their motivation by their choices, thus finding ways which enable them to express themselves and thereby improve their welfare." (Manning, 2009, p. xix). For example, rats work harder to access cage with other rats than an empty cage (Patterson-Kane, Hunt & Harper, 2002) and mink push doors with heavier weights to access a water bath than an empty cage or a cage of novel

objects (Mason, Cooper & Clarbrough, 2001 – see Dawkins, 1988, for more examples).

The obvious difficulty with the revealed preference test is that an animal may have a strong preference for things which are not in its best long-term interest (Timberlake, 1984). The dog of my childhood worked very hard indeed to access three packs of butter on a kitchen counter. Ingestion of that much butter had some very regrettable short-term consequences, and, if he had been able to access butter as often as he would have liked, the long-term prognosis probably also would have been poor. Timberlake (1984) offers better-controlled examples.

Animals may also prefer more familiar environments over novel, improved ones (Dawkins, 1980).

More generally, there are diverse notions of well-being (a zoologist and a veterinarian may have quite different opinions on the idea of allowing a female to bear young, for example), including relative valuations of shorter- and longer-term consequences, and it simply cannot be assumed that an individual's own preferences match the course of action best for its health and well-being.

The second approach in applied ethology is the investigation of ancestral species' spontaneous behavior as a guide to the behavioral welfare of captive and domesticated species. Dawkins (2006) summarized this approach by pointing out that domesticated and other captive species have a legacy of responses to threats that enabled them to survive in the wild. It is assumed that current behavioral responses reflect these evolved behavioral tendencies.

On its face this is a valid observation but implementation for domesticated animals may be problematic. Much current dog trainer lore, for example, is predicated on early ethological studies of wolf behavior (e.g., Monks of New Skete, 1978; Millan & Peltier, 2007). Of course, ethologists cannot be blamed for the garbled and outdated versions of their research that are promulgated by popularizers, but the general approach of looking to wild populations for guidance in handling captive groups is intrinsically risky. Domestication can lead to very rapid behavioral change as seen most dramatically in the artificial domestication of red foxes (*Vulpes vulpes*) by Belyaev, Trut and their collaborators (Trut et al.,

2009; Dugatkin & Trut, 2017), but also in the domestication of other species such as dogs (Coppinger & Coppinger, 2002).

The third major approach of applied ethology is the alteration of the environment to permit animals to express more 'natural' behavior and thereby improve welfare. The assumption behind these manipulations is that animals have 'ethological needs' (Hughes & Duncan, 1988; Dawkins, 1990). Consequently, they can suffer if they are unable to express their normal range of behavior patterns. Hogan (2009) traces this line of thought back to William James (1890: Vol. 2, p. 286): "every creature *likes* its own ways." Lorenz (1937) also proposed that performing fixed action patterns is pleasurable.

The problem with this assumption is that we lack independent measures of the animal's hedonic state and animals clearly do *not* enjoy expressing some of their natural behaviors. The behaviors of prey species in evading predators are highly unlikely to induce positive hedonic states, for example. But even within positive, appetitive, behaviors we may not know how much difference the opportunity to engage in a behavior makes to the total hedonic calculus of an individual animal at a particular moment.

In practice, applied ethologists have offered to improve the welfare of farm and zoo animals by comparing their behavior repertoires to those of groups of the same species living under less constrained conditions and recommending changes to holding conditions to enable the animals to express more of their behavioral repertoire. As a 'clinical' approach this is very limited. It unnecessarily constrains the range of tools that someone desiring to improve an animal's behavior might apply. It is also not really a clinical approach in the sense that it does not deal with animals singly but rather as groups or populations.

Behaviorism

There exists an alternative approach to animal behavior: Behaviorism.

Behaviorism is premised on the assumption that behavior is determined by the stimuli that preceded and follow it.

Behaviorism and ethology have been and continue to be perceived as in opposition to each other, but it is worth considering how many principles they share.

The history of behaviorist psychology stems just as much from the ramifying implications of Darwin's great insights as does that of ethology. Edward Thorndike, often viewed as a founder of the behaviorist movement (even if he had left animal behavior studies before that term was coined) was a student of William James, the founder of functionalism (Goodwin, 2015). Functionalism was the first school of what is now known as 'evolutionary psychology.' The originator of late-phase behaviorism, B. F. Skinner, was also always aware that behavior had to be understood as a product of evolution (even if it is a fair criticism that he seldom deployed that knowledge) (Skinner, 1966).

Behaviorists share with ethologists a belief in empiricism and an eschewing of mental states (unlike Darwin who was quite comfortable with mental explananda: Darwin, 1871; Burkhardt 2005). Tinbergen (1951) for example, dismissed subjective phenomena from ethology as impossible to observe objectively: "it is idle either to claim or to deny their existence."

Modern, Skinnerian, behaviorism calls itself Behavior Analysis, and, like ethology, the behavior analytic approach to animal behavior also has some serious limitations.

The basic science of animal behavior analysis (what its practitioners call the 'Experimental Analysis of Behavior' EAB) has a tradition of simply ignoring most behavior. Animals are shut into windowless boxes and behaviors of interest are automatically recorded on electronic machinery. Thus most commonly a pigeon (*Columba livia*) or rat (*Rattus norvegicus*) (both examples of the partially domesticated species known as 'vermin') may be placed in a metal box approximately twice as long as the animal in each dimension. That cube will contain a metal bar for a rat to press or a plastic disk for a pigeon to peck on. After an initial phase during which the animal is brought to operate the response device by judicious delivery of food, the experimenter closes the lid and attends to nothing more about what the animal is doing beyond the count of pecks or bar

presses recorded automatically. The animal's behavior has no topography – not even duration. The only dimension of the behavior in the box is rate: how often the response occurs per minute (see Ferster & Skinner, 1957, for a massive compendium of behavior recorded solely as counts per minute). There were some interesting exceptions to this generalization (see, e.g., Smith, 1974; Davey & Cleland, 1982), but in general the form of behavior was not a major interest of the EAB movement.

The restricted range of species studied in EAB has also frequently been mentioned. Skinner titled his magnum opus "The Behavior of Organisms" (1938) – even though all the studies reported in it were carried on just one species of mammal – the white rat. The implication was that behavior, at least the behavioral processes behaviorists were interested in, were common to all animals. Another founding behaviorist, Edward Tolman, actually dedicated a book to the white rat (Tolman, 1932).

A tradition of not looking at the animals is hardly conducive to a clinical approach, and yet a powerful and highly successful applied domain developed out of behaviorism. This is known today as Applied Behavior Analysis (ABA). ABA started to develop out of EAB already in the 1950s (Rutherford, 2009). It has become an enormous professional field focusing on behavioral problems in humans with a special focus on abiding developmental disorders such as autism. Curiously, where ignoring most of what the individuals under study are doing was central to EAB, behavioral observation was recognized as essential to ABA already by the mid 1970s. For example, Johnson & Bolstad described behavioral observation as the "greatest contribution of Behavior Modification to the treatment of human problems" (1973, p. 7 – cited in Hartmann & Wood 1990: 'Behavior Modification' was an earlier moniker for ABA) By 1980 a bibliographic survey reported that over 70% of research articles in major ABA journals employed observation (Bornstein, Bridgwater, Hickey & Sweeney, 1980) Where ignoring the bulk of an animal's behavior may have constrained the development of EAB, Skinner's insistence on the study of individual subjects has proven highly valuable in the development of a clinical science – since clinical

behavioral problems present one individual at a time and often require unique treatment regimens.

Behavior analysts take it as axiomatic that any behavior that occurs repeatedly must be reinforced by some consequence in the environment (Skinner, 1965). Rather confusingly they refer to this as the 'function' of the behavior. Clearly what they are specifying here is a behavioral *mechanism* - not a function (e.g., Iwata et al. 2000). The toolkit of the applied behavior analyst consists largely in identifying these sustaining consequences and modifying the individual's environment to break the relationship between these behaviors and their reinforcers (and, potentially, introducing new behavior-reinforcer relationships to sustain supplanting behaviors – a process known as Differential Reinforcement of Alternative behavior - DRA).

ABA has been strikingly successful in treating behavioral disorders in our own species. One way of measuring the success of ABA is the number of certified practitioners. The Behavior Analysis Certification Board was set up in the 1990s to credential people to work in the field (Johnston et al., 2017). The BCBA qualification requires a master's degree following a detailed curriculum from a program accredited by the CBBA. At the end of 2019 there were 37,859 BCBAs worldwide.

By contrast, the Animal Behavior Society – the major US society for the study of animal behavior from an ethological point of view, offers an accreditation for work in applied animal behavior. The Certified Applied Animal Behaviorist (CAAB) title is available to practitioners with a PhD, and the Associate CAAB (ACAAB) to those with a master's degree. There is some specificity to the syllabus that must be followed, but it is not as rigid as for the BCBA qualification, and the ABS does not accredit degree programs. At the end of 2019, there were 37 CAABs (of whom three had emeritus status) and 15 ACAABs.

It should be clarified that BCBAs do not work with animals (at least not by virtue of their certification) and CAABs do not work with people. Thus we would not expect as many animal practitioners as human ones just as there are more human physicians than veterinarians. There are around 113,000 veterinarians in the USA

(AVMA, 2018) compared to around 900,000 human physicians (different sources give different totals: 861,000 according to AAMC, 2015; 954,000 according to Young et al., 2017). The ratio of veterinarians to physicians is thus a little more than 1:9. The ratio of CAABs and ACAABs to BCBAs is less than 1:1,000. In other words, clinical ethologists are exceedingly rare compared to behavior analysts applying behaviorist methods to the treatment of human behavioral problems.

The biggest problem with ABA as an approach to clinical animal behavior problems is simply that it has hardly ever been applied to non-human subjects. Of the 103 papers published in the most recent four issues of the senior journal in ABA, the *Journal of Applied Behavior Analysis* (Volume 52 part 4 through volume 53 part 3) just a single paper concerned a non-human subject (Morris & Slocum, 2019). It is particularly surprising that ABA has ignored animals since the fundamental research in EAB – which is perceived by the ABA community as providing the theoretical underpinnings to their work – was largely carried out on nonhuman subjects (Madden, 2013).

Another possible drawback of the ABA approach to behavioral problems in animals lies in the behaviorists' relative lack of interest in evolutionary function. Since ABA practitioners largely work with their own species, perhaps it could be argued that the function of behavior can be assumed to be understood. It might perhaps also be argued that when people have behavioral problems, ultimate evolutionary function is not as important as proximate function in society. Excellent counter arguments to these points have been made too. Nesse (2019) for example, argues that understanding the evolutionary function of behavior can be highly advantageous in assisting people who are in behavioral or psychological distress.

Though overlooking evolutionary function may potentially create a problem in applying the ABA approach to animals, it should also be noted that the functionality of the behavior of domesticated species – which is where most clinical problems arise – is often highly questionable. Dogs (*Canis lupus familiaris*) are an excellent example to consider. Dogs are the most widely owned

pet animal in the United States with around 70 to 80 million individuals in human households (Rowan, 2018). They are also very widespread throughout the world, with perhaps 800 million individuals on every continent that humans have settled (Rowan, 2020). Dogs were the first animal species to enter domestication – in fact the first domesticated organism of any phylum (Larson et al., 2012). All dogs of all breeds are descended entirely from grey wolves (*Canis lupus)* with a point of origin between 15,000 and 32,000 years ago.

One widely reported behavioral problem that raises interesting questions about function is coprophagy: the consumption of feces (McKeown et al. 1988). People find coprophagy highly distasteful. It is a taboo practice in many human societies and especially distasteful in pet dogs given how closely they live to their human hosts. People can be quite uncompromising in their insistence that their dog must stop "eating poop."

Viewed from an ethological perspective, however, coprophagy simply is not a behavioral problem. In rural Zimbabwe free-living dogs obtain over 20% of their diet from human feces (Butler 1998; Butler & du Toit 2002). Feces are an excellent source of nutrients and dogs are very unlikely to catch infectious disease or parasites from the denizens of a first-world household. Thus there is only one point of view from which coprophagy can be construed as a problem behavior – and that is the standpoint of a human householder and dog owner who does not want the animal with which they share their couch and bed to have the odor of feces in its mouth.

From an ethological perspective there would not appear to be anything to recommend to an individual who arrives at the behavioral clinic with a dog showing this 'problem.' It would be little consolation to the dog's owner to be told that this is a 'natural' behavior, a form of scavenging functionally well-fit to the dog's adapted niche on the fringes of human settlements. In terms of mechanism (*sensu* Tinbergen, 1963) we could wonder together at how the taste buds of the dog must be wired so differently from the human case that a dog could eat such a thing with enthusiasm, but this does not seem likely to open a treatment

modality. Presumably the only possible treatment would be the commonsensical one of keeping the dog away from feces.

An Applied Behavior Analyst on the other hand, has, by training, not been encouraged to consider the ultimate consequences of behavior in a species' phylogeny and evolution. Even if the behavior is species-typical (as coprophagy is for dogs) that does not enter into her calculations in considering a treatment. Nonetheless, an ABA practitioner would have a range of treatment options at her disposal. A simple management approach like ensuring that the dog does not have access to feces might be sufficient. Another possibility might be adding a harmless but unpleasant-tasting substance to feces the dog would otherwise consume. Technically, this would be operant punishment and BCBAs are discouraged from seeking solutions involving punishment. Thus a slightly more elaborate approach such as DRA might be considered first. In a DRA, the animal would be reinforced (rewarded) with a preferred consequence when it engages in any other behavior than the one the behavior analyst desires to reduce. Thus the dog might be given a preferred treat for progressively longer periods without attempting to consume feces.

One might wonder, in line with Dawkins (1990), whether depriving the dog of this opportunity to engage in species-typical behavior might be an impingement on its quality of life. For a dog living alongside humans, however, the fitness implications of failing to adopt human-compatible behavior can be far more serious than the frustration of not being able to select its preferred diet. Behavioral problems in the home are a major cause of relinquishment of pet dogs. Since dogs – in most first world countries – are not tolerated living beyond human captivity, the consequences of failing to adapt to the human household may be terminal.

Integrated Clinical Animal Behavior: An Outline

To be effective, the clinical investigation and treatment of animal behavior problems needs to integrate the key insights of both ethologists and behavior analysts. I outline here the four steps that this involves.

First, it would be foolhardy to attempt to understand problem behaviors without identifying the functions of those behaviors in an evolutionary sense and in an

397 animal's species typical behavioral repertoire in an unconstrained 'natural'
398 environment. I say this even though I have expressed skepticism towards the
399 value of that knowledge, nonetheless, it is basic information without which it
400 would be unwise to proceed with a treatment. Even if one has to over-rule the
401 animal's preferences and spontaneous inclinations, it is wise to be aware of them.
402 The well-known example of Keller Breland and Marian Breland is highly relevant
403 in this context. This husband and wife team, behavior analysts trained by Skinner
404 himself, had gone into business to train diverse species to perform tricks for
405 television and other entertainment contexts. As they applied reinforcers to modify
406 behavior – the technique they had learned in Skinner's pigeon lab at Harvard –
407 they found that the animals' behavior would tend to develop towards more
408 species-typical morphologies. They termed this phenomenon 'instinctive drift'
409 (Breland & Breland, 1961). Consequently, to avoid trying to work against an
410 animal's spontaneous behavioral tendencies, it is wise to have a rounded
411 awareness of behavior in more natural contexts.
412 Furthermore, when dealing with species that have not been extensively rewarded
413 by people in the past, consideration of the evolutionary context can aid
414 identification of what an animal is likely to find reinforcing (rewarding). That
415 said, for the domesticated species that are the majority of a clinical animal
416 behaviorists case load we must be careful not to assume that domesticated species
417 and subspecies are essentially identical in their needs to their wild-living cousins.
418 Of course, for many domestic species, the identity of suitable rewards is likely to
419 be common knowledge.
420 Second, we need to observe the individual's behavior. Most likely this will take
421 the form of an ethogram analysis. In the case of pet animals, it is possible to have
422 the animal's owners complete a questionnaire to assess frequency of problem
423 behaviors, but it is surely superior to have direct behavioral observations. Even if
424 EAB often eschewed behavioral observation, the importance of this step is shared
425 by ethology and ABA. The ABA perspective adds in an interest in paying
426 attention to any sequencing of problem behaviors with possible attractive
427 consequences (reinforcers) which might be maintaining the rate of the behavior.

Ethologists are more likely to look out for 'releasing stimuli' – stimuli in the environment that regularly precede and trigger the undesired behavior. Both of these are very valuable.

For the third step, ABA offers methods to identify phenomena in the animal's environment which may be acting to reinforce the problematic behavior. These include the 'functional analysis' mentioned above (Iwata et al., 2000). In this case, putative reinforcers are presented to the individual one at a time and the rate of the problem behavior is noted. These may include reinforcers identified during baseline observations or that have previously been found efficacious in prior studies.

Fourth, the context of the animal's behavior can be altered to remove the stimuli preceding or following the problem behavior. Preceding stimuli are likely to be termed 'releasing' or 'conditioned' stimuli. Succeeding stimuli are known as consequences or reinforcers. ABA also recognizes the possibility of manipulating 'motivating operations' as a way of altering behavior. Motivating operations are conditions that make a particular consequence reinforcing – or, conversely, reduce the effectiveness of a reinforcer. Simple examples would include feeding or withholding food in order to make food a more or less effective reinforcer respectively.

Integrated Clinical Animal Behavior: Some Examples

The effectiveness of an approach that integrates the key insights of ethology and behaviorism can best be illustrated with some examples.

Protopova and Wynne (2014) adopted an ethological approach to investigate the interaction of people looking to adopt a dog and the dogs living at a shelter they were considering as potential pets. The experimenters video-recorded the interaction between the adopter and dog and then scored against an ethogram all the behaviors of the dog both independent of and in interaction with the person considering adopting them. The outcome of this ethogram analysis was then set in relation to the recorded result of that interaction – i.e., whether or not that person adopted that dog. This conceptually straightforward correlational analysis had a striking outcome: Of the many things the dog might do when removed from its

kennel, only two had a significant impact on the dog's likelihood of being adopted. Those two behaviors, however, each had a very substantial impact on the dog's chances of leaving the shelter. If a dog responded positively to a potential adopter's invitation to play – independent of what sort of play that was – the dog's chances of adoption increased over 100 fold; and a dog that lay down in proximity to the person increased its chances of adoption over 14 fold. No other behavioral factors predicted the dogs' outcomes.

This simple ethological analysis provided very powerful information, but, on its own, it does not provide a practical course of action that could be implemented by shelters to improve their charges chances of adoption. For an implementable treatment, Protopopova et al. (2016a) turned to ABA.

For a qualified applied behavior analyst, or an animal trainer, shaping a dog to respond positively to a play invitation and to lie down close to a person are trivial tasks. This project to improve the adoptability of shelter dogs' behavior was made challenging, however, by the need for training to be rapid, cost-effective and scalable, and also produce a perceptible change in response towards member of the public who would not be involved in the training program.

Training the dogs to respond positively to people's invitations to play is rendered complex by the wide range of different toys and games that a potential adaptor might try and engage a dog with. Rather than the more time-consuming and expertise-demanding approach of training all dogs to respond positively to all forms of play invitation, Protopopova et al. (2016a) instead performed a preference assessment to ascertain what kinds of play a particular dog might be interested in. The first toy that the dog engaged with was noted as that dog's preferred form of play and only this toy was made available to potential adopters. In addition, the dogs were trained to lie down in proximity to the adopters by putting it on a short leash and showing potential adopters how to encourage the dogs with treats to lie down by them.

The adoption success of dogs in the intervention group was significantly greater than for dogs in a control group who received customary treatment: 39.2% of dogs in the intervention group were adopted after interacting with a member of

the public, compared to 23.3% in the control group. This finding is particularly impressive because animal shelters are intrinsically noisy locations with many additional variables that can impact a dog's chances of adoption and consequent survival. This study shows how melding ethological and behavior analytic approaches into an integrated study of clinical animal behavior can pay dividends in developing time- and cost-effective behavioral interventions that save lives.

Sometimes the topography of the problem behavior is so obvious that assessing behavior against an ethogram would be inefficient. In the case of canine stereotypic behavior even a lay person can readily identify when a dog is engaging in repeated, apparently purposeless, actions such as repetitive licking or sucking, chasing of the tail, moving lights or shadows, or biting at an invisible fly – or similar. Several studies have identified putative underlying biological mechanisms but there is little consistency between these studies and they have limited treatment implications. Dodman et al. (2010) found a genetic contribution to the problem behavior in Doberman pinschers – however Tiira et al. (2012) failed to replicate this finding in bull terriers, Staffordshire bull terriers and German shepherds. Ogata et al. (2013) reported structural brain alterations in dogs with stereotypic behavior problems.

Burn (2011) noted that people could be seen encouraging the animals in 43% of 400 videos on the internet of dogs chasing their tails. Hall et al. (2015) picked up this observation and investigated the possible role of a purely behavioral mechanism – a reinforcer that increases the rate of the behavior. In an initial survey, one third of respondents whose dogs showed stereotypic behavior reported they had sought professional help and most responded to their dog's behavior in some way. Although the owners' responses were probably intended to reduce the frequency of the behavior, Hall et al. explored the possibility that these consequences could actually be *increasing* the likelihood that the undesired behavior recurs in the future.

Initially, Hall et al. (2015) carried out the classically ethological approach of observing the problem behavior naturalistically in the environment in which it occurs – the dog's home. Hall et al. also spoke to their dog's human owners –

which does not occur in classical ethology but is certainly consistent with naturalist observation when the species being observed is linguistically competent.

Next Hall et al. (2015) deployed an ABA 'Functional Analysis' on five dogs with persistent stereotypic behavioral problems. Possible consequences that could be reinforcing the behavior were presented systematically contingent on the problem behavior. Different consequences were tested for different dogs depending on the initial observations and conversations with owners. The consequences included: Movement of the light; removal of the light; human attention; and the owner approaching the house door. In each case, suitable control conditions such as a light that could not move and did not turn off, noncontingent human attention, and the human not moving towards the house door were included.

In each case, Hall et al. (2015) were able to identify a single consequence that maintained the dog's problematic stereotypic behavior and then instituted suitable behavioral treatments by manipulating the consequences of the behavior.

When a problem behavior is maintained by the behavior of the human caregiver – as was the case for three dogs in Hall et al.'s (2015) study – alleviating the problem can be as simple as instructing the humans to change their behavior, for example by no longer paying attention to the dog when it spins or licks the floor. Changing behavior when the reinforcing consequence is intrinsic to the natural environment – as when a dog is reinforced for chasing lights by the movement of the light beam – is more challenging, but not beyond the arsenal of behavior-changing methods available in ABA. With one of the dogs that chased lights, Hall et al. (2015) instituted a DRA procedure by first training the dog to raise its paw on the verbal command "wave," and then introducing the "wave" command under conditions of progressively increased flashlight intensity. If the dog attempted to chase the light it was turned off, but if the dog did not chase the light and instead waved its paw, it received food reinforcement. In this way, Hall et al. (2015) were gradually able to reduce the dog's problem behaviors to much lower levels.

This study also shows the value of combining ethological and behavior-analytic methods. The observation of behavior preceded the analysis of consequences that

could be reinforcing the problem behavior and the deployment of a treatment method that focused on using reinforcing consequences to alter the behavior towards a more desired pattern.

Sometimes it may even be possible to successfully correct a problem behavior without needing to examine its spontaneous occurrences in any detail. Barking when left home alone is a frequent problematic behavior of pet dogs. Although the behavior is often linked with separation anxiety and treated with medication (e.g., Podberscek, et al., 1999; King et al., 2000; Takeuchi, et al., 2000), it may be possible to approach the problem therapeutically with a direct behavioral method. Protopopova et al. (2016b), simply measured the mean time between spontaneous barks when left alone in five dogs reported by their owners as showing problem barking. An experimenter hiding in the bathroom of the dog's otherwise empty home then delivered food through a remote-controlled feeder contingent on the dog remaining silent for progressively longer intervals. For three of the five dogs this treatment was successful, and for a fourth the outcome was unclear. Further refinement of the technique may make it effective in a larger portion of dogs with this common problem, and the recent development of devices that can automatically detect dog barks and deliver treats may make it possible to fully automate this treatment. This is ethically preferable to the presently common punishment-based approaches (e.g., Juarbe-Díaz & Houpt, 1996; Wells, 2001; Moffat et al., 2003; Steiss et al., 2007; Sargisson et al., 2012).

Conclusions

Animal behavioral problems are too important and widespread to be left to the disciples of any one approach to understanding animal behavior. Success in helping animals to survive and thrive in a human-dominated world demands that concerned practitioners put aside the intellectual barriers that developed in the last century between schools of animal behavior that actually share a great many basic assumptions.

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