Beyond operant

Emotion, arousal and cumulative

by Melissa Starling
an APDT Member

In the year 1908, about 7 years after Pavlov documented conditioned reflexes and gave us the basis for classical conditioning, and almost 30 years before Skinner coined the term "operant conditioning", one Robert Yerkes and John Dillingham Dodson published a paper that earned them the distinction of getting a law named after them.

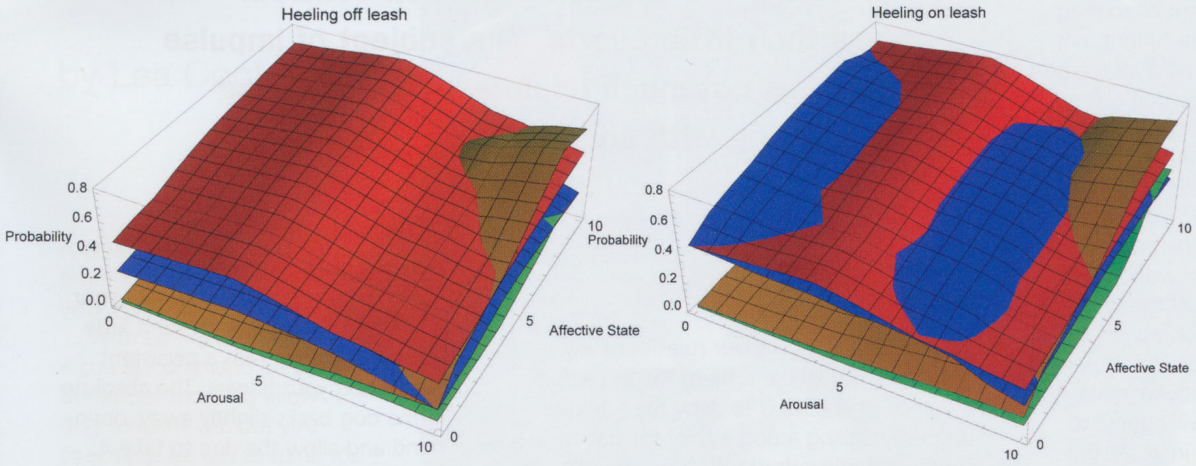
Despite the fact that the Yerkes-Dodson law is now used to describe the effects of arousal on performance, it was actually published before the concept of arousal had been articulated. The original study discusses the relationship between strength of stimulus on "habit-formation", which we would now call learning a discrimination task. The strength of stimulus referred to the strength of the electric shock their study mice received when they made the incorrect choice. Later on, the Yerkes-Dodson law was extrapolated; assuming strength of stimulus was basically the same thing as arousal.

Classical conditioning and operant conditioning went on to become cornerstones of modern animal training, but somehow Yerkes-Dodson got the short end of the stick and became somewhat overlooked in the revolution. Last year I wrote a paper for the open access online journal Animals where I reinstated arousal as one cornerstone of training, along with operant conditioning and a modernised take on classical conditioning that we'll call emotional state. The paper is available online here: http://www.mdpi.com/2076-2615/3/2/300 for people who want the full story and don't mind heavy academic language. It does have some very pretty 3D graphs that anyone can enjoy, and if you follow the link in the paper to the graph files and download the Wolfram CDF player, you can play with the graphs in 3D yourself and see them from different angles. It may help illustrate the concepts in the paper and this article, and it's also pretty fun.

Firstly, a note on terminology. Emotional state, as far as anyone knows, is comprised of two components: emotional valence and arousal. Emotional valence refers to how positive or negative the emotional experience is. Think of the how classical conditioning creates positive or negative associations on a continuum depending on the strength of the stimuli involved. Because scientists are to various degrees naturally compelled to invent new terminology, this concept is also sometimes loosely referred to as affective or emotional state, or even just affect, even though I just said emotional state encompasses valence and arousal. Emotion is hard to quantify and sometimes we don't exactly know whether we're talking about just valence or valence and arousal. Arousal and emotional valence are thought to be independent, but combine to produce general moods. For example, high arousal and positive emotional valence results in an excited, happy state, whereas high arousal and negative emotional valence results in a fearful, agitated state, and low arousal and positive emotional valence results in a calm, content state.

Arousal refers to a state of wakefulness or alertness. Arousal was first considered as a generalised construct, in which only a single type of arousal exists that affects all types of behaviours equally at once. The Yerkes-Dodson law is a good example of this. The law indicates that there is an optimal level of arousal for best performance of any given task. But that optimal arousal level changes depending on the nature of the task. In general, where arousal is low, under-stimulation may result in slow performance or lack of interest in performing at all. As arousal increases, performance increases, but for complex, difficult, or unfamiliar tasks this trend peaks at moderate arousal and after that, as arousal continues to increase, performance suffers due to decline in concentration and precision. This relationship is called the inverted-U. But if

conditioning—
experiences in training



the task is simple or well known, task performance continues to increase as arousal increases. In recent times, arousal is understood as more likely to have several specific types of arousal linked to various goals like feeding, defence, etc. But these ideas are still being developed. The generalised Yerkes-Dodson construct is the best we have at the moment.

Intuitively, one might predict emotional valence to have an immediate impact on an animal's performance in operant conditioning training. For example, surely if the animal is having a negative experience they are less likely to respond to our training cues. Recently it has become possible to explore this scientifically as new indicators of emotional state are being developed. Perhaps the most promising is cognitive bias, which uses the fact that animals experiencing general negative emotional valence tend to expect negative things to happen to them, while animals experiencing positive emotional valence tend to expect positive things to happen to them. By measuring whether they expect more good outcomes or poor outcomes it's possible to infer backwards to what emotional valence may be producing their expectations. This is an exciting area of research I'm involved in currently. Theoretically, an animal's emotional experiences become cumulative, so the more positive experiences they have, the more positive experiences they expect, and the more positive experiences they expect, the more engaged they become in their environment and interactions with objects or beings within it. Think of an animal that is frequently seeking positive experiences and access to reinforcers, is resilient to aversive experiences, and willing to take risks. There are advantages to working with such an animal, as they are likely to be persistent, easily motivated, and readily offer new behaviours. Great for clicker training! At the other end of the spectrum, the more negative experiences they have, the more negative experiences they expect, and thus the less engaged they become. They may be prone to identifying threats where there are none. Think of an animal that is seeking to avoid aversive experiences, may be prone to over-generalisation of aversive experiences, and is risk-averse. From a training perspective, such an animal may be difficult to motivate with positive experiences, easily discouraged, and unwilling to try new behaviours.

Classical conditioning and operant conditioning went on to become cornerstones of modern animal training, but somehow Yerkes-Dodson got the short end of the stick and became somewhat overlooked in the revolution.

We already know from the Yerkes-Dodson law how arousal may influence the effectiveness of operant conditioning. The main question is whether the task we are asking of our dogs is easy or difficult. In a dynamic environment with competing stimuli, it's probably fair to say it is usually difficult. So it would follow we want moderate arousal. What if our dog has low arousal? Punishment is unlikely to be helpful, because it doesn't offer incentive to DO anything. Reinforcement of either positive or negative kind may be more helpful in providing the dog with the motivation necessary. As arousal increases, the dog is expected to become more resilient to aversive experiences, and at very high arousal, punishment may serve to bring arousal down and in that way actually facilitate training efforts by getting the dog in a more appropriate level of arousal, which is not to say that is good training. If the dog has low arousal and a negative emotional state, it is both poorly motivated and emotionally sensitive to aversive experiences. Such a dog may be moderately responsive to positive reinforcement, but is probably more interested in avoiding aversive experiences than seeking out positive experiences. Thus negative reinforcement may prove to be effective if skilfully used. As the dog's emotional valence moves from positive to negative, they are likely to become more interested in accessing reinforcement than avoiding aversive experiences. This is great for positive reinforcement training, but it

comes with the baggage that at very positive emotional state and high arousal, we have a dog who may turn out to be eager to race off and find their own reinforcement if we don't keep the reinforcements we can control coming. At this point negative punishment may be highly effective if you hold all the best reinforcement cards. If you don't, the reinforcements you don't control may become a liability in training with a dog that thinks the world is one big pokie machine.

So in conclusion, the operant conditioning quadrants all work, but do not all work equally well all the time. The reason why they don't, assuming the trainer is proficient, is in large part because arousal and emotional state both impact on a dog's willingness to offer behaviours, interest in accessing reinforcers, and resilience to aversive experiences.

If we want to be humane trainers, we should not be picking our training methods based on quadrants. Rather, we should be striving to set our animals up with the arousal and emotional valence that will both give us the most flexibility and success in our training as well as making training an enjoyable activity with minimal conflict of interest for our animals.

Melissa Starling is a PhD candidate working in the field of animal welfare and behaviour. She completed her undergraduate studies at the Australian National University where she did a Bachelor of Science. Her Honours project was on brood parasitism in the Pallid Cuckoo and resulted in the discovery of cryptic gentes in a cuckoo species. She spent approximately 4 years in the work force as an environmental consultant building skills in animal identification, habitat assessment, and survey techniques, and then embarked upon her PhD in the Faculty of Veterinary Science in 2010. Her project is on cognitive bias as a measure of welfare and personality in the domestic dog, and covers such diverse areas as ethology, cognition, affective state, behaviour and welfare. She lives with two dogs of the hund variety and a handful of doves, all of whom have been introduced to the clicker.

Part one
IMPULSE

Most dogs are impulsive and self centred, bless their little hearts. The subject of impulse control is not much explored when thinking about living with and or training your dog.

STEALING IS AN ANTHROPOMORPHISM

Dogs don't play by our rules naturally. They don't understand them. Giving a dog a human character is to deny their unique dogness. Calling a dog a thief for taking something misunderstands why dogs do things. If the leaders of the pack walk away from a kill, the next and subsequently lower level is permitted to eat, and then the next level until there are only bones and fur left. Survival of the pack depends on the best distribution of food. If you the loving leader leave a plate of dinner on the coffee table and you walk away, it is up for the quickest to take amongst your dogs. If you want to leave food on the coffee table, teach the leave it cue before you allow the dog to take what you are abandoning.

RANK THE REINFORCEMENT

Make sure that you rank the food into 5 levels of desire by your dog.

- 1 would be a pretty uninteresting piece of dry food for example.
- 2 would be of a higher scale of desirability until you get to the number
- 5 which of course would be maximum desirability.

If you have a dog that is very hungry, starting with a 5 could mean damage to your hand. With a dog that is not really food hungry, 1 would not be very motivating.

LEAVE IT

A simple exercise to teach: take a small piece of food in your hand. Place the food hand near your dogs nose your palm upwards and in a closed fist so the dog cannot take it. Wait whilst the dog paws at your hand, sniffs, perhaps barks, demands, and demands or chews at your fingers. You may have to wait for a little time; perhaps a glove with a persistent dog will protect your fingers. The absolute instant the dog backs slightly away, open your hand and allow the dog to take it. Wait until the dog clearly backs away before releasing the food. Mark the backing away with a "yes" or "click" to mark the behaviour as desirable and a promise of food to come.

Puppies are easy to teach and they have less biting power than an adult dog. The bigger the dog the bigger the teeth. A hungry puppy can become hyper aroused so some puppies are better taught on a full stomach.

Repeat approx 10 times then finish training with a "free" or "go play" cue and do something else. Come back ten minutes later and repeat approx 10 times.

You will notice that he backs off faster and faster, sometimes offering a sit or drop to get you to feed him quicker.

I don't like the dog offering behaviours too much as the dog may run through a repertoire of "tricks" without actually thinking about what you really want.

This type of dog can become hectic, frustrated and shut down the training game. Keep giving the dog a freedom ("Free") cue when you are finished. Develop duration by adding more time before you open your hand. Count silently to yourself, starting at 1,2, open your hand after the dog backs away. Go longer as you think he understands.

Go up in increments of a couple of seconds. If you are having failures, break the behaviour down into smaller (successive approximations) pieces and set yourself up for success. Two failures in a