ANIMAL TRAINING

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APPLIED THEORY

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Introduction

Animals' surroundings are filled with environmental changes they need to adapt to if they are to survive. Both seasonal variations that are more or less predictable, and sudden changes are events animals need to handle as well as interaction with each other. By learning they can adapt to these changes and start acting appropriately upon them as they appear (Bolles 1972) and the animals' responses to different situations will be modified based on their experience. Learning is, of course, of great advantage for their chances to reproduce and ultimately for their survival.

When looking into the literature there are different definitions of learning that gives slightly different explanations of what learning implies. Pearce (1997) definition of learning implies a change in an animal's response to a situation. Note, Pearce writes about changes that are relatively permanent and based on experience. Kimble (1961) cited in Kratzer (1971) pp.1, also means that learning is more or less permanent, whereas Cooper (1998) states that it is not permanent. Cooper instead suggests that learned responses both could be refined as well as reversed, due to environmental changes that may and do occur. Of course, there are responses that are relatively permanent if the situation they appear in does not change, e.g. mammalian herbivores that learn by experience which level of toxins different plants contain (Provenza et al. 2003). However, the herbivores rather regulate their intake than avoid poisonous plants completely (Iason and Villalba 2006). There are also learned behaviours that, though they have been used for several years, need to be revised for the animal to survive. For example, changes in the landscape that causes redistribution of food, which makes the animal change their foraging behaviour.

This potential to change behaviours has historically been used to study the different learning processes by training animals in different settings (Pavlov 1927; Skinner 1938; Thorndike 1898) and still is. The knowledge of how to teach animals new behaviours has been developed, and today training is also something commonly used in captive animal management. Training of animals has proved to be beneficial to help animals cope better with life in captivity, i.e. increase the captive animals' welfare (Colahan and Breder 2003; Prescott and Buchanan-Smith 2003; Savastano et al. 2003), and it has been

widely applied in many different species and settings (Breland and Breland 1961; Priest 1991; Pryor 1999; Ramirez 1999) as more and more Zoos and other captive animal settings introduce different behavioural management programs. Laule and Whittaker (2007) review three reasons why training benefits the captive animal management: training improves 1) husbandry and medical care, 2) social management and 3) the psychological wellbeing of the animal. This is accomplished by training the animals to voluntary cooperate during routine procedures, by teaching the animals to work together resulting in an increase of affiliative behaviours and by using desensitization techniques to reduce their stress (Laule and Whittaker (2007).

The aims of this study are to review different concepts of training. In the first part I will look into how learning is theoretically categorized and in the second part review the applied effects of different training techniques.

Learning in theory

As mentioned in the introduction, learning is essential for the animals' survival. By learning how to react appropriately to different kinds of stimuli animals can enhance their chance to stay alive and reproduce.

When looking into the behaviour ecology literature there are limited writings about learning, and when studying the literature about cognition and learning only little is said about the adaptive and evolutionary value of learning. Staddon (1983) "*Adaptive behaviour and learning*" is one book that binds these pieces together and that discusses the adaptive value of learning: how animals learn to act appropriately to different types of environments depending on their past experience of similar environments as well as their evolutionary history. By interpreting the stimuli from their surroundings animals learn how to behave correctly.

To understand the concept of animal training the different mechanisms behind the process of learning need to be understood. This understanding will act as tools for you as a trainer. The tools are useful in different circumstances and the more knowledge there is about what tool to use properly when and how, the better is the chance to

succeed when training animals. Therefore, this essay starts with a systematic description of the different mechanisms affecting the learning process in animals.

The processes of learning are categorized into different concepts to facilitate the understanding of how and why different behaviours occur (Fig.1). *Associative learning* is when the behaviour change is because of an association between events, e.g. when an animal learns that when the doorbell rings there is a human being on the other side of the door. Then there are other types of learning (also known as non-associative learning), such as desensitization and sensitization. These happen when there is a change in behaviour because of a single event that is repeated, e.g. when an animal gets used to people walking by and no longer reacts to the appearance of them. Two other types of learning are *Social learning* and *Imprinting*, respectively, where the first involves learning by observing others (Emery and Clayton 2005) and the second involves both insight and conditional features (Reznikova 2007).

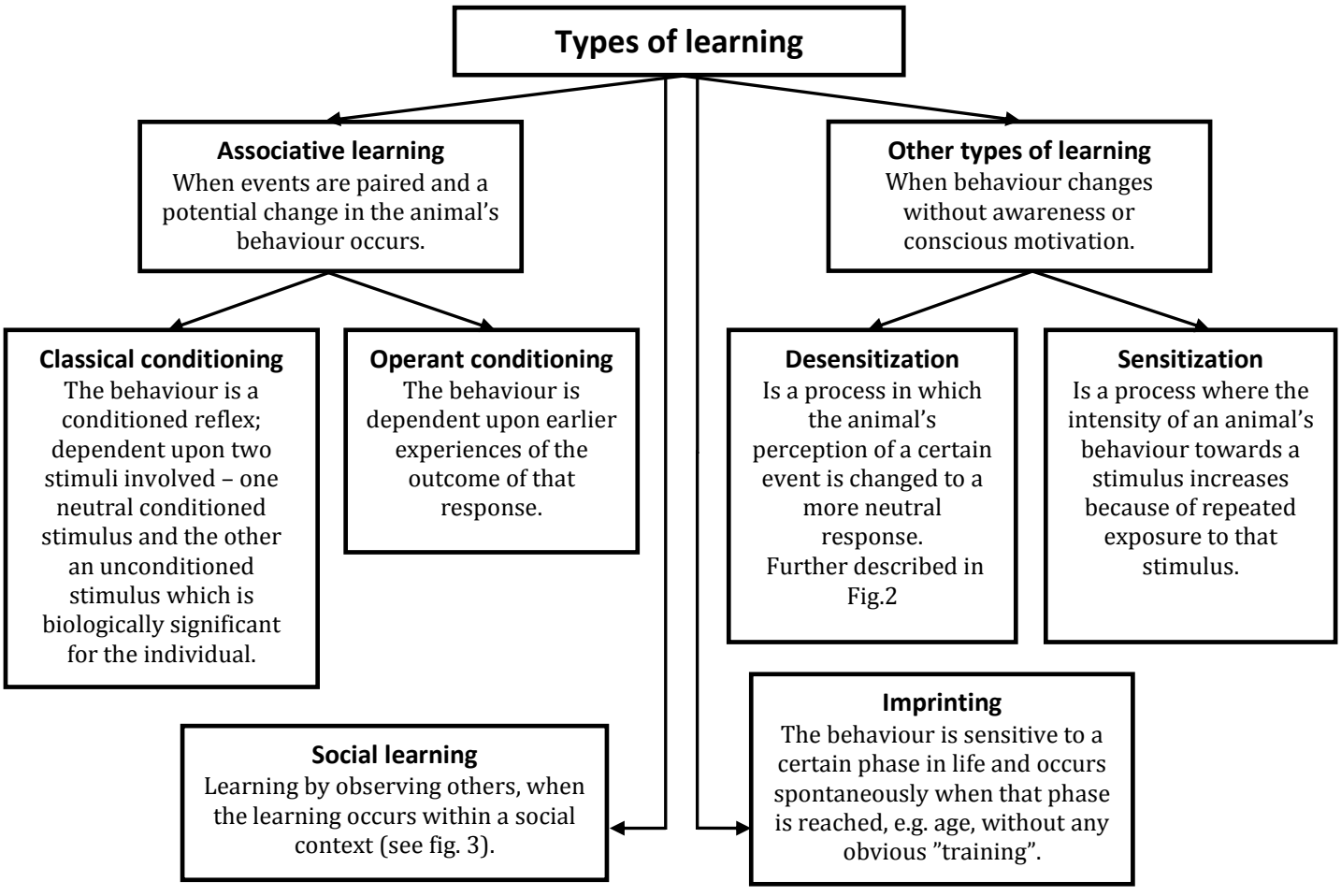

Figure 1. Different learning types described and their connection illustrated.

I will present these types of learning by going through the theory behind them, the different categories within them and look more thoroughly into how they are applicable in the daily work of an animal trainer.

Associative learning

Associative learning takes place when events are paired and a potential modification in the animal's behaviour ensues (Pearce 1997). By interpreting the surroundings, the animal learns how to predict events and also how the animal should act upon these stimuli. As mentioned above, an animal's surroundings are filled with both relevant and irrelevant information, and by learning which stimuli that is of importance these associations can make a difference for the animal's survival.

Associative learning has been categorized into two phenomena useful when describing why behaviours change: **classical conditioning** and **operant conditioning**, where the first involves how new reflexes develop and the second involves how behaviours controlled by their consequences develop (Vargas 2009). Hence, the two methods describe how and why different kinds of behaviours are expressed depending on how different events affect them.

Classical conditioning

Classical conditioning (also known as Pavlovian or respondent conditioning (Pearce 1997; Vargas 2009) was described by Pavlov (1927) as conditioned reflexes. The two events that are paired are one initially neutral stimulus that precedes or coincides with an unconditioned stimulus that is biologically significant for the animal (Pearce 1997). One example is food, where the **respondent**[1] behaviour will occur as a reflex to a certain stimulus (Vargas 2009). When you, for an example, taste a lemon you will start salivating. This is an unconditioned response to the taste of the sour juice, an unconditioned stimulus. The salivation is a reflex – a physiological reaction to the **antecedent**[2] stimulus – a behaviour **elicited**[3] by the taste from the lemon. By pairing a

[1] Respondent behaviours can be explained as responses to stimuli as a part of a reflex.
[2] Antecedents are stimuli, contexts or settings that occur before the behaviour and influence the action of it.

neutral stimulus, for an example the sound of a bell, that is an neutral stimulus with no initial effect on the reflex response, with an unconditioned stimulus such as food, Pavlov (1927) illustrated that the new stimulus elicited the same response – in the case described above the bell started eliciting salivation. The previously neutral stimulus then becomes a conditioned stimulus and the response a conditioned response (Vargas 2009). Notice that classical conditioning acts upon reflexes, meaning that no new behaviours are developed during classical conditioning – only the triggers that elicit them. However, as classical conditioning influences motivation, operant behaviours may also be shown in response to conditioned stimuli (see below).

However, there are events that can develop a classically conditioned association between two stimuli without unconditioned dimensions (Pearce 1997), for an example serial conditioning. Holland and Ross (1981) trained rats with the sequence: light – tone – food, when they found that the light could evoke the otherwise only tone elicited behaviour 'head jerking'. The observing of this behaviour suggested that the rat anticipated the second event (tone) with help of the light and responded to the light as if the tone were actually present, though it was not.

Operant conditioning

Operant conditioning, also called instrumental conditioning, is based on learning about responses and was proposed as early as 1898 by Thorndike (1898) but it was not until Skinner (1938) that the process of operant conditioning was studied more in depth (Vargas 2009). Behaviours that are operantly conditioned are said to be **emitted**[4] (Vargas 2009), which means that when an animal respond to a stimulus with an operant behaviour, that behaviour is controlled by earlier experience (Pearce and Dickinson 1975) and an active choice may also be implied, i.e. in operant conditioning it is the consequences that controls the behaviour (Laule et al. 2003) in contrast to classical conditioning where the response is triggered by the event preceding it.

[3] Elicited behaviours are controlled by stimuli that precede them.
[4] Emitted behaviours are dependent and controlled by earlier experience of the outcome of that response, i.e. their relation to postcedents.

The consequences of a response can be affected by reinforcement, punishment or extinction (Vargas 2009), se below. When describing responses, the stimuli that follow the behaviour (the **postcedents**[5]) are defined by how they affect the recurrence of behaviour.

Response consequences

Consequences that can follow behaviours are: reinforcement, punishment and no perceived change in stimuli. Knowledge about the functional effect of consequences is of importance when managing behaviours. The trainer is able to control, choose and use the best consequence in different contexts, and to understand what effective output a consequence could have depending on the situation where it happens. Further consideration about consequences in different training situations is found under *Effects of different training techniques*.

Reinforcement

Reinforcement is any consequence that strengthens the behaviour and increases the probability for that response to occur again (Skinner 1938) and has a motivational significance to the animal (Mackintosh 1975).

Reinforcements can be either positive or negative. **Positive reinforcement**[6] means that stimulation is *added*, while **negative reinforcement**[7] means that stimulation is *reduced/taken away* (Vargas 2009). For an example, if the music is too loud you turn the volume down (negative reinforcement – sound is removed) and if it is too soft you turn it up (positive reinforcement – sound is added), either way the knob turning in both cases is reinforced. Hence, the behaviour of knob turning increases. When using negative reinforcement correctly the desired behaviour should turn off the aversive event immediately (Kazdin 2001).

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[5] Postcedents are what follow the action of the behaviour.
[6] Positive reinforcement, when a stimulus added increases the probability for that response to occur again.
[7] Negative reinforcement, when a stimulus reduced/taken away increases the probability for that response to occur again.

Hineline (1977) cited by Iwata (1987) writes that negative reinforcements involve two processes that produce behaviours: *escape* – removal and reduction of on-going stimulation, and *avoidance* – postponement and prevention of stimuli, respectively. It should also be noted that it is the termination of the stimulation that strengthens the response (Ramirez 1999), negative reinforcement is mediated by aversive elements the animal wants to avoid (Arhant et al. 2010).

Before proceeding, a short discussion about negative reinforcement should be highlighted. Michael (1975) commented about the ambiguous distinction between positive and negative reinforcement and Hineline (1984) discuss how to differentiate between positive and negative reinforcement (pp. 496-497). When using negative reinforcement the animal's initial responses to the aversive stimuli must happen in the presence of the stimuli for the stimuli to be reducible or removable (escape) – later, when the animal has learned that the cue announces an impending aversive stimulus, it can avoid it altogether by performing the response on cue (avoidance). In contrast, when using positive reinforcement the animal's response to the reinforcement based stimuli needs to happen in the absence of that stimulus.

Though, Iwata (1987) argues that positive and negative reinforcement are potentially interchangeable as there sometimes is a question of how to accurately characterize certain stimuli. He exemplifies this problem with the change in temperature: is the change a presentation of cold/heat or a removal of heat/cold? Scientist working with the two consequences should be aware of this dilemma to avoid negative effects on the experimental procedure, interpretation and later application.

When looking more thoroughly into the definition of reinforces, Premack (1965) cited in Pearce (1997) suggested that instead of looking at reinforces as stimuli, they should be seen as opportunities for the animal to engage in the behaviour that are associated with the reinforcement. Thus, it is not the food or ball itself but the activity of eating or chasing that is the reinforcement. Furthermore, Premack (1962) suggests that if a response is more probable than another response that response is a reinforcer. This implies that if an activity could be seen as reinforcing, the subject should rather engage in that activity compared to the activity that is to be reinforced ((Premack 1965) cited

by Pearce (1997)). That is, if the rat wants to run in a wheel but has to drink water to gain access to the wheel, running in the wheel serves as a reinforcer for drinking if the drinking behaviour will increase (Premack (1971) cited by Pearce (1997)).

When working with animals, knowledge about what is reinforcing for that animal is of great value to succeed in changing the behaviour of animals (Ramirez 1999). Especially since it is not always obvious for a trainer what reinforces an animal's behaviour, and if the trainer wishes to control the behaviour she or he seeks to control the reinforcing factors.

One example when the reinforcing properties are not completely clear for the trainer is for example when the animal starts doing behaviour to seek attention. In the beginning these behaviours can be subtle; the monkey turns away and looks like if it is going to leave its station. The trainer sees this and quickly gives the animal a cue and reinforces its response. Since the cue itself is reinforcing for the animal (will be discussed below under *secondary reinforcements*) the animal soon associates the *turn away* with the cue – the turn away has been reinforced. Gradually the behaviour *turn away* may progress into *go away* and now the trainer has a problem getting the monkey to stay at its station at all without giving the animal his or her full attention.

Knowing the reinforcements connected to a problematic behaviour and taking control over them is the best way to deal with undesirable behaviour (Pryor 1999).

Since changes in reinforcements is considered to be an important factor in learning (Domjan and Burkhard (1986) cited by Cooper (1998)) and since it is the reinforcing consequences rather than the antecedents that direct the outcome of an animal's behaviour, reinforcement is the foundation in **Positive Reinforcement Training**[8]. This is a training technique in which animals are rewarded when performing desirable behaviours (Desmond and Laule 1994; Laule et al. 2003) and that ignores undesirable behaviours (**extinction**[9]). It is commonly used in marine mammal training and has also

[8] Positive Reinforcement Training (PRT) is a training technique in which animals are rewarded when performing desirable behaviours.
[9] Extinction is when reinforcements that have maintained a specific response diminish or disappear and the behaviour they have reinforced will stop.

reached the captive animal management where it is highly recommended (Pryor 1999; Ramirez 1999).

In positive reinforcement training the trainer uses different kinds of reinforcers to control the behaviour of the animal. These reinforcers are categorized as primary and secondary reinforcement, respectively.

A **primary reinforcer**[10] or *unconditioned reinforcer* does not need to be paired with another stimulus to function as a reinforcer (Pearce 1997), the animal finds it inherently rewarding (Ramirez 1999). Examples of primary reinforcers are e.g. food, water and sex. However, Feh and de Mazières (1993) suggested that stroking near preferred allo-grooming sites might be rewarding to horses. Note, the value of the same primary reinforcer may differ between individuals (Skinner 1974), and may also differ over time within individuals (Clay et al. 2009b). Performing a preference test may enhance the training and make it more effective (Martin et al. 2010) as it gives you the tool to work with the most desirable reinforcer for the moment for that specific individual.

When a new stimulus is paired with a primary reinforcer repeatedly or when a stimulus has served as a discriminative stimulus for an instrumental food-getting response and this new stimulus gains reinforcing properties (Hyde 1976; Ramirez 1999) it is called a **secondary reinforce**r[11] or a conditioned reinforcer. The strength of the secondary reinforcer is linked to the frequency of primary reinforcement taking place in its presence (Kellher and Gollub 1962) and can become an alternative to the primary reward if repeatedly used together with a primary reinforcer (Cooper 1998).

As mentioned above, also a cue can be assumed to act as a conditioned reinforcer (Westlund 2012) as it informs the animal that if you perform the behavior correctly

[10] Primary reinforcers are inherently rewarding for the animal.
[11] A secondary or a conditioned reinforcer is a stimulus that has been paired with an existing reinforcer until it becomes a reinforcer itself.

reinforcement will follow (Mills 2010). When associated with a secondary reinforcer, the cue is sometimes called a **tertiary reinforcer**[12].

Punishment

Any action that decreases or weakens the behaviour is called punishment (Skinner 1938) i.e. the probability of a response to not recur increases. Punishment, as well as reinforcement, consists of positive and negative events. **Positive punishment**[13] means that a stimulus is *added* – also known as "punishment by application", while **negative punishment**[14] means that stimulation is *reduced/taken away* - also known as punishment by removal (Vargas 2009). For an example, if a dog is on its way to urinate on a carpet and the owner yells "No" and gives the dog a swat on the nose (aversive stimuli) the dog most probably will avoid urinating on the carpet again – decrease of undesirable behaviour. The dog has been exposed to positive punishment. When negative punishment is used instead, something desirable to the animal is removed. If an animal in the middle of a training session starts to do an undesirable behaviour, e.g. vocalize loudly, the trainer can chose to take away the opportunity to earn reinforcers each time the animal gives these unwanted sounds. This loss of reinforcement will most likely lead to decrease of the undesirable behaviour.

Vargas (2009) points out that punishment cannot build behaviours and the emotional side effects it may produce is undesirable, e.g. aggression (Herron et al. 2009), behavioural stress responses (Schilder and van der Borg 2004) and the acquisition of phobias or fears through classical conditioning. Bolles (1970) also proposed that one of the animal's species-specific defence reactions, freeze, flee or fight, will be part of their response in avoidance learning. This implies that when punishment is used; the trainer can expect that parts of the animal's response may include parts of the animal's defence reactions. For instance, if the trainer uses aversive elements when training a recall; he or she may have an animal coming when recalled, but who slows down when coming closer

[12] Tertiary reinforcer, a stimulus, such as a cue, associated with a secondary reinforcement.
[13] Positive punishment, when a stimulus added results in a reduction of the affected behaviour.
[14] Negative punishment, when a stimulus taken away/reduced results in a reduction of the behaviour.

to the trainer (*freeze*), an animal that avoids coming when recalled (*flee*) or an animal that tries to defend itself by attacking the trainer (*fight*). When teaching new behaviours reinforcement offers better methods of control (Vargas 2009).

Though, even in training programs relying mostly on positive reinforcement training there are elements of correction used, and one of these elements is a **Time Out**[15].

Time Out is a negative punishment where the opportunity to earn a positive reinforcer is made unavailable (Leitenberg 1965). Negative punishment, where you take the reward away, is frequently used, because the reinforcer is a consequence the trainer often easily controls. In a Time out, however, the trainer takes all the rewards and turns away from the animal or in some circumstances the trainer, without any frustration, may even put the animal away for a while (Ramirez 1999). Therefore a Time out is considered in the animal trainer community to be more aversive for the animal compared to other types of negative punishments.

Kaufman and Baron (1968) concluded in their study that a Time Out could produce aversive effects, as strong as the aversive stimulus of shock (Richardson and Baron 2008), which is supported by other studies (e.g. (Ferster 1957); but also see the review of (Leitenberg 1965)). Time Out is therefore seen as an advanced training technique, which should be used carefully and with respect (Ramirez 1999). In the animal training community Time Out is often only used when animals expose aggression towards other animals or the trainer (Ramirez 1999), which is a dangerous behaviour that can be difficult to control with reinforcers. Important to notice is that a Time Out is only effective if the animal enjoys the training situation and wants the offered rewards. If the animal wants the trainer to go away the intended Time Out could be interpreted as a negative reinforcement by the animal instead, i.e. the threat of the human goes away if the animal shows aggression. If this is the case it is easy to control for: is the undesirable behaviour increasing or decreasing in response to the Time Out? If the Time Out works, the behaviour will decrease in frequency or intensity.

[15] Time out is a negative punisher that takes away the opportunity for the animal to earn a positive reinforcer.

No perceived change in stimuli

When reinforcements that have maintained a specific behaviour diminish or disappear the behaviour it has reinforced will stop, i.e. the behaviour will undergo the process of extinction (Vargas 2009). However, a behaviour that has been continuously reinforced during a long period will not decrease smoothly or gradually. Before the behaviour declines there will be an increase in the intensity or frequency of the response – a so-called **extinction burst**[16] will appear. Skinner (1938) also noticed that during the process of extinction new, though, related behaviours were produced as well, which he called 'response induction'. Therefore, extinction has also been found to initially increase variability (Galbicka 1988; Neuringer 2002). This response induction is especially useful during the process of **shaping**[17] (see below) as it makes it possible for the trainer to shape new behaviours through the behaviours the animal offers during the extinction process.

Extinction and extinction bursts are processes animal trainers should be well aware of since undesirable behaviours continue to increase in both frequency as well as in intensity because of ignorance about these processes. In addition, even if the behaviour has undergone extinction and is no longer in the animal's repertoire it is not forgotten (Vargas 2009) and the behaviour may have a 'spontaneous recovery'; learned patterns are not broken down by extinction (Neuringer 2002).

Extinction is part of positive reinforcement training, where undesirable behaviours are ignored. One way to reduce behaviour is to use a *Least Reinforcing Scenario* (LRS), a form of correction when dealing with undesirable behaviours consisting of a 3 to 5 seconds neutral response from the trainer when the animal does an unwanted behaviour (Scarpuzzi et al. 1991). The difference between an LRS and a Time Out is that during an LRS nothing in the training session changes, there is just a short pause before the training begins again. When giving a Time Out, the trainer either turns around or

[16] Extinction burst is an increase in the force or frequency of action and happens before a response under extinction declines.
[17] Shaping is a training process in which the trainer differentially reinforces changes, i.e. intensity or direction, in an animal's existing behaviour and gradually guides the animal's behaviour into a new behaviour.

even walks away, to indicate clearly that "you have lost your chance to earn a reward" (Ramirez 1999).

Correctly performed the LRS is used the instance when the conditioned and the primary reinforcer usually would have appeared if the animal had done a correct response. However, because the animal performed an unwanted behaviour the trainer does nothing during these couple of seconds. The trainer simply ignores the unwanted behaviour for a couple of seconds and after the given LRS continues the training session as if nothing had happened. If the LRS works properly the animal will decrease the unwanted behaviour and try harder to perform the desirable behaviour next time it is given a chance.

According to Ramirez (2011b) an LRS is considered to be sorted under the power of extinction. However, when looking at the Punishment-Reinforcement continuum, it is considered to be at the reinforcing side, though it is a way to reduce unwanted responses from the animal (Scarpuzzi et al. 1991).

Some final thoughts about response consequences; when behaviours are discussed, I believe it is of importance to make a proper analysis of which stimuli affect the behaviour and what effects those stimuli have on the behaviour. For instance, in the case of the doorbell situation described above, is the dog barking at the door because it wants the person behind the door to come inside the house faster or is it barking at the door because it guards the house and wants to get rid of the person behind the door? And, in either case, what consequences does the barking usually have? When deciding a way to decrease the barking at the door, the trainer needs to understand what elements affect the behaviour.

Before going further into other types of learning, it should be pointed out that operant conditioning and classical conditioning often function simultaneously (Mackintosh 1975). One of them often dominates the other in different situations, depending on the amount of response feedback and the relationship between the response and the reinforcer. One example where you can see these two working together is when thoroughly watching an agility competition – dog jumping competition. Many handlers teach their dog to stay on the marked fields on the contact obstacles. The stop is an

operant behaviour, taught to the dog, but when the dog stands there you can see many dogs drool. Drooling is a response that confirms that a classical conditioning has occurred at the same time as the stop, i.e. the dogs have associated the stop with food, since food is often used as a reinforcement to teach the stop.

When thinking of stimuli, one should also remember that it is both the existence as well as the omission of a stimulus that gives the animal information about their surroundings, i.e. conditioned stimuli can signal both the coming occurrence of unconditioned stimuli (*excitatory conditioning*) as well as the absence of unconditioned stimuli (*inhibitory conditioning*) (Mackintosh 1975). To describe this in an applied situation we can use the door-bell situation mentioned earlier, where the door-bell signals to the animal the occurrence of a human on the other side of the door, i.e. an excitatory conditioning. When giving an example of inhibitory conditioning we can think of the door only; as the door closes behind the human this event tells the animal the human has left the building. Now the animal is home alone and free to do whatever it wants without getting reprimands from the human.

Social learning

Learning by observing others, also known as observational learning, is when the learning occurs within a social context (Emery and Clayton 2005). There are several different forms when looking into the process of 'mimetic' processes according to Whiten (2000), who has made a taxonomy over the 'mimetic' processes, which makes it easy to overview. Social learning (Fig.3) is one 'mimetic' process of three – the other two is 'social influence' and 'non-social processes' and will not be discussed further here.

When addressing social learning, individual B learns from individual A in different ways: stimulus enhancement, observational learning, imitation and goal emulation (Whiten 2000). Emery and Clayton (2005) also write about local enhancement.

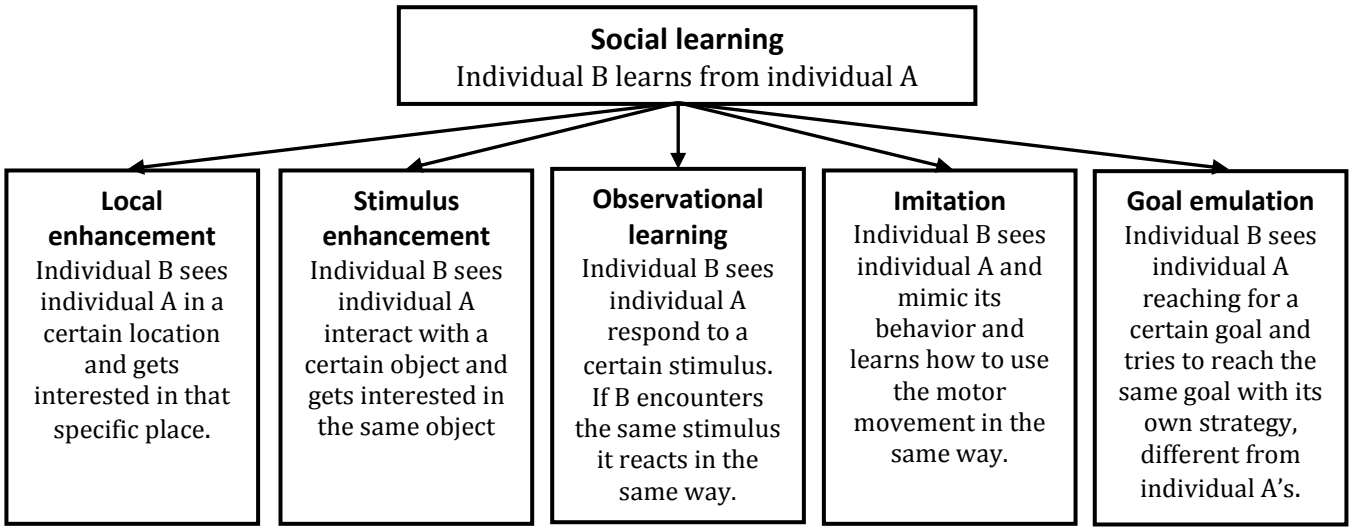


Figure 2. An illustration of the different processes of social learning.

Local enhancement. The observer (B) sees another individual in a certain location and *gets interested in that particular place*. It is not until B is in the same place that the individual might get interested in the objects that are there. Cooper (1998) mentions the use of this form of learning when teaching horses to load. By letting the horse observe another horse enter the transportation box the observing horse gets more interesting in the box, which simplifies the training. Though, it could also be the mere presence of another horse that makes the horse calm and easier to load (social facilitation), rather than social learning.

Stimulus enhancement. The observer *gets interested in the same object*, that another individual has interacted with before (Emery and Clayton 2005). For example, this could be helpful in target training. If a monkey sees another monkey interact with a target stick, the observing monkey may have a tendency to get more easily interested when exposed to it afterwards.

Observational learning. The observer sees how another individual reacts to a certain stimulus (Emery and Clayton 2005). If the observer encounters the same stimulus it will respond in the same way as it saw the other individual react, e.g. if an animal sees another animal react with fear towards a human, the observing animal most likely will respond in a similar way if encountered with a human.

Imitation. The observer mimics the model's behaviour and learns how to use the motor movement in a correct way. For instance, learning how to operate a machine by watching another individual do it (Dautenhahn and Nehaniv 2002).

The difference between observational learning and imitation is that the first implies the animal's reaction towards an object or person while the second implies the actual motor movement behaviour to manoeuvre a machine in a proper way, for example.

Goal emulation. The observer aims to reach the same goal as the model is attempting to reach (Emery and Clayton (2005). To reach the goal, the observer does not mimic the models strategy. Instead the observer tries to find out his or her own strategy to reach the goal. Tomasello et al. (1987) and colleagues illustrated how chimpanzees that had observed other chimpanzees using tools to reach a reward also used a tool, but instead of using the same technique they chose another technique to reach the reward.

The differences between emulation and imitation is that the observer's goal in the first case is to copy the same result as the model and in the second case to copy the models action, i.e. motor pattern (Dautenhahn and Nehaniv 2002).

For ways of generating new behaviours using aversives, see below.

Imprinting

In the context of different types of learning also imprinting should be mentioned. Imprinting is when a behaviour occurs spontaneously when a certain sensitive phase in life is reached, e.g. age, without any obvious "training" (Staddon, 1983) and includes both conditional as well as insight features (Reznikova 2007).

There are two kind of imprinting: filial imprinting and sexual imprinting, respectively. Filial imprinting brings the young under its parent's control and makes the young follow its parent's warnings and escapes if necessary. Sexual imprinting, found in some species, helps the animal find the correct sex and species for mating.

Other types of learning

Associative learning, as described above, involves two events that are paired which have the potential to change the behaviour of the animal. However, sometimes learning takes place without this association process, and sometimes these other types of learning is called non-associative learning. These learning processes need neither awareness nor conscious motivation to occur. However, these processes enable animals to handle both relevant as well as irrelevant information from their surroundings.

To illustrate this form of learning I will start with an example; you have for the first time taken your horse into a new stable and it stands silently when a door suddenly opens. The first reflex for the horse will most probably be to shy away and get distance to the frightening event: the opening of the door. Reflexive responses like this are thought to be highly stereotypic, but can be changed (Chance 2009) trough repeated exposure to different stimuli that either decrease (*habituation*) or increase (*sensitization*) (Cooper 1998) the intensity of the response.

Firstly, animals can learn to **habituate**[18] to irrelevant background stimuli that repeatedly elicit a given response (Chance 2009). Gradually, because of a repeated exposure to the stimuli, the intensity of the response will decrease, i.e. they learn to ignore irrelevant stimuli that have proved to be neither beneficial nor harmful (Cooper 1998). The adaptive value of habituation is to prevent the animal to react to every little stimulus in its surroundings over and over again. If exposed to an event for the very first time, the animal should give it attention. However, if the event does not have any value for the animal, this attention could be directed towards more important events in the animal's surrounding, such as foraging or predator prevention. The animal simply filtrates all information it is exposed to. Another common example is birds along the road that have been habituated to cars and hardly react when they drive by. Or if we take the horse mentioned above, it will gradually learn to ignore the opening of the door, and stand silently although people are coming in and out through the door. Though, it is of value to remember that habituation is a 'reversible process' (Thomson and William

[18] Habituation is the decline in responsiveness to a stimulus when repeatedly exposed to it.

1966), if the opening of the door one day brings an unpleasant event (associative learning) the horse might start responding to the opening of the door again depending on how frightful that event is. However, the habituation process will proceed faster if the animal is exposed to the stimulus again, provided that it was not harmful (Thomson and William 1966).

In the example above, with the horse that reacts to the door, the horse will hopefully gradually get used to the door and not react to it every time it opens. But, sometimes the animal does not habituate to stimulus, instead **sensitization**[19] can follow. Sensitization is when the animal's response to a stimulus instead increases and makes the animal respond even more intensively to the stimulus (Chance 2009). The adaptive value of sensitization is to increase the animal's awareness of its surroundings. For instance, if a deer hears a branch break it gets alert and starts to listen with attention to other sounds to be able to detect potential danger. In animal training, an animal's increased alertness to its surroundings may cause problems. Gunshot sensitivity, for example, is a common behavioural problem in dogs. Here the dog's reflex response, e.g. crouching or jumping, after a shot has a tendency to increase in intensity after each repeated exposure. This sensitivity to sudden and loud noise may even be transferred to other sudden noises in the near surroundings of the dog, for instance, dropped objects on the floor, which before did not affect the dog. It is obviously something that can be problematic in a training situation, if the animal gets sensitized to stimuli the trainer wishes it to ignore.

Both of these processes, habituation and sensitization, are always present, simply, the animal needs to learn how to categorize the information in its surroundings. Both can be of help as well as a problem in the training situation, and by awareness of their effects they can be used appropriately in training. Especially **desensitization**[20] techniques, such as habituation, counter-conditioning and systematic desensitization (described below), where the animal's perception of a negative or positive event is changed to a more neutral perception (Ramirez 1999), can be of great value. For instance to reduce animals' fearful reactions to novel stimuli that for different purposes are needed in the

[19] Sensitization is the increase in responsiveness to a stimulus when exposed to it repeatedly.
[20] Desensitization is a process in which the animal's perception of a certain event is changed to a more neutral response.

training situation: equipment, personnel, or other materials (Bloomsmith et al. 2006) or to reduce arousal when an animal's expectation is very high, e.g. in competition environment.

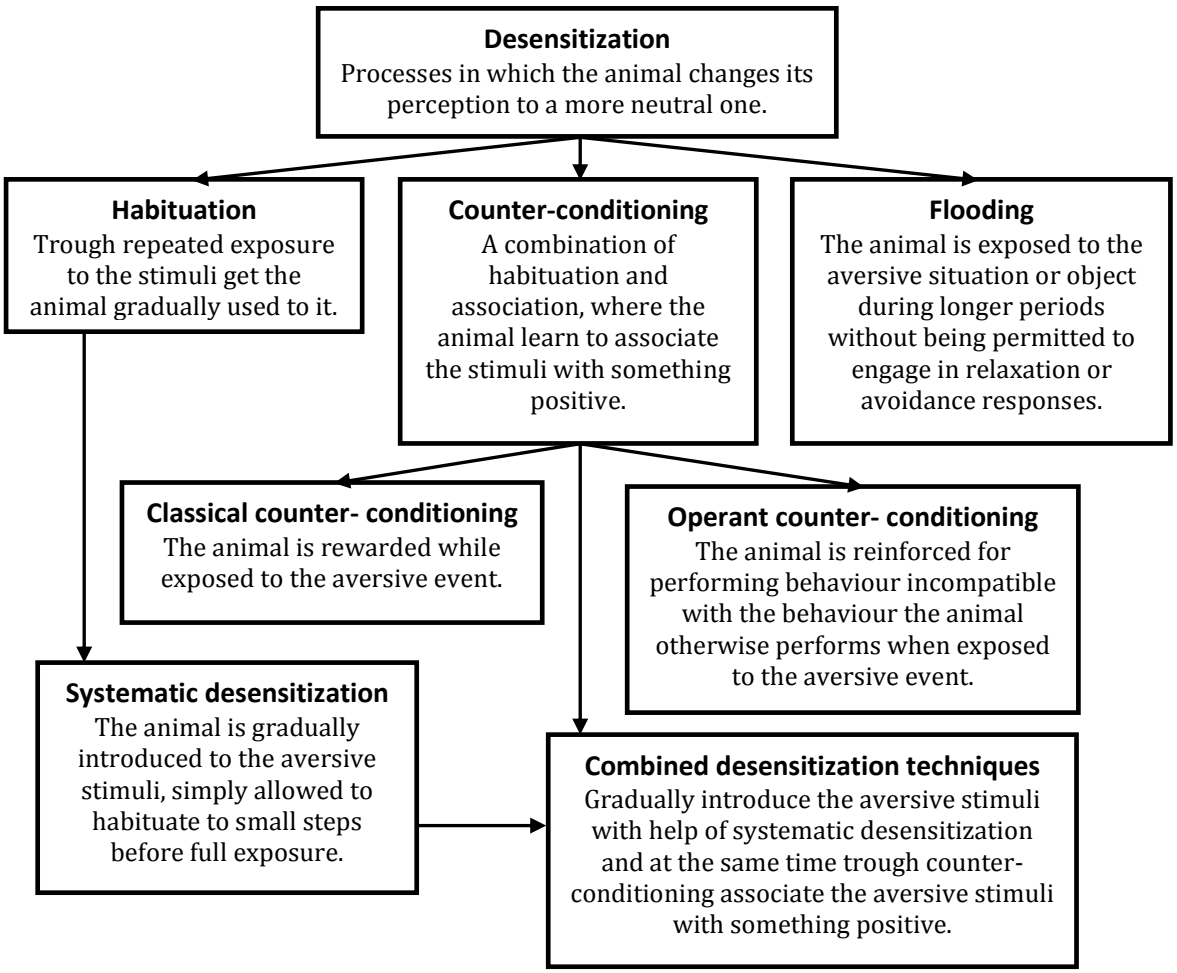
Sometimes only habituation is not enough to decrease the fearful responses the animal may experience (Bloomsmith et al. 2006). When an animal, for example, has experienced a stressful capture where it was put into a cage with force it can be difficult to teach it to voluntarily enter any cage because of the fear associated with the earlier experience. In this case the active process of **counter-conditioning**[21] could be used. This technique involves both the implicit process of habituation as well as an associative process, which is further described below, where the fear-eliciting stimulus gets associated with something positive to the animal. Such a combination is considered to be the most effective way to reduce fear-responses (Goldstein 1969) and this positive association will gradually change the animal's previously normal defence reaction (Pearce and Dickinson 1975) and make the animal more comfortable with the situation.

Yin (2009) also makes a difference between classical counter-conditioning and operant counter-conditioning. When considering the first process, the animal is reinforced while exposed to the aversive event regardless of the animal's behaviour, and in the latter the animal is reinforced when performing a behaviour that is incompatible with the response the animal does when exposed to the aversive event. As an example we can take the often aversive event when the agility seesaw moves downwards towards the ground. If using classical counter-conditioning the trainer would feed the dog during the whole procedure and gradually get the dog to accept the movement of the seesaw. When using operant counter-conditioning instead, the trainer teaches the dog to perform a certain behaviour that it is asked to perform during the movement, e.g. lay down, which is incompatible with jumping off. If the dog lies still while the seesaw is moving it will be reinforced.

[21] Counter conditioning is an active desensitization technique where habituation and an association process is combined.

Another form of desensitization is **systematic desensitization**[22] (Clay et al. 2009a) where the animal instead is gradually introduced to the aversive stimulus, i.e. it gets habituated to each step before the full stimulus is applied (Christensen et al. 2006; Gough 1999). Christensen et al. (2006) studied horses and found that systematic desensitization was more efficient than counter conditioning. In contrast, Yin (2009) asserts that systematic desensititization works best for low-level fears and that it needs to be combined with counter conditioning for higher-level fears. Indeed, Clay et al. (2009a) revealed in macaques that this kind of combination training was effective.

Flooding is another technique used when dealing with fear responses, where the animal is exposed to the aversive situation or object for a longer period and not allowed to perform any avoidance responses or to escape the fearful situation (Baum 1969).



3. An illustration of the different desensitization techniques.

[22] Systematic desensitization is when the subject is gradually exposed to the aversive stimulus, always below threshold for the response, to enable the subject to gradually get used to it.

Inconsistent terminology

Authors who write about the techniques described above need to clarify how their training is done, as there seems to be an inconsistency when using the terminology of habituation, desensitization and counter-conditioning. Hurley and Holmes (1998) suggests that the process where the animal gets used to novel stimuli is called desensitization and could be divided into the passive process of habituation and the active process of counter-conditioning. The use of desensitization as a general definition of this "get-use-to-stimulus-process" is not found in other literature. Even though others also put habituation as the passive process and counter conditioning as the active process, e.g. Chance (2009) and Clay et al. (2009a). However, Chance (2009) means that desensitization is the same as counter conditioning. If the terminology is specified clearly, confusion could be avoided.

Another thing that sometimes causes confusion among the general public is the differences between extinction, punishment and habituation, which all lead to a decrease in behaviour. Simply described by Yin (2009) they work in somewhat different ways. Extinction works on behaviours that have been reinforced, and through the use of extinction no longer are reinforced. Since the reinforcing has stopped, the response of that behaviour will decrease gradually. Punishment decreases the behaviour by actively influencing the consequences that affects the behaviour, by the addition or removal of stimuli. The difference between extinction and negative punishment is that during extinction nothing will happen when the animal does a behaviour but if using negative reinforcement the reinforcer will be taken away if the animal does the behaviour, i.e. passive and active consequences. Habituation works on a stimulus that has no reinforcement history. Though, as described above, there are different techniques where reinforcing properties can enhance the habituation effect, e.g. counter-conditioning.

To be certain what effective output a *response consequence* (negative or positive reinforcement or punishment) has, the outcome of that consequence needs to be evaluated by observing the target behaviour – is the behaviour increasing or decreasing? When the trainer can control the surroundings of the animal he or she can also manage the animal's behaviour in a more effective way.

Conclusion

As an animal trainer it is of importance to understand the basics of the described processes, as they give the trainer an understanding of how different training techniques work. This knowledge will then help the trainer to decide which technique to use in different situations and contexts that gives the best results and how to refine them to suit the set training goal best.

Generating new patterns of behaviour

"*If I want to succeed in bringing a person towards a particular goal, I must first find her where she is and start right there*" (Kirkegaard).

In animal training we seek to control the behaviour of the animal but also to generate new patterns of behaviour that suits our expectations. There are several ways how new behaviours in animals are generated. Animals learn from their environment and their experience, are taught new behaviours by guidance from their trainers and sometimes from each other. By teaching the animal new ways to respond to different situations and cues we are able to manage them more properly.

Shaping

Shaping is a process in which the trainer reinforces changes in an existing behaviour, changes such as intensity, direction or other qualities, by gradually guiding the animal's behaviour into a new behaviour (Vargas 2009). The procedure and the word *shaping* were born and used for the first time 1943, when Skinner and Breland gradually produced a new form of behaviour by hand when teaching a pigeon to bowl, i.e. to tip pins with a small bowl (Peterson 2004). Skinner had been describing methods of successive approximation – how learned behaviours gradually developed – in previous works, but that described training had always been performed by equipment and not deliberately performed by a human (Vargas 2009). This discovery was described as an

"*illuminative surprise*" and Skinner (1972) cited by (Peterson 2004), realized that the training of animals could be more effective and faster if it was done by the trainer's hand instead of the use of a machine. This since there can be an instant change of the criterion being reinforced depending on how the shaping of the behaviour progresses.

In the process of shaping both reinforcement and extinction are applied in combination by systematically and gradually changing the response criteria and only reinforcing behaviours meeting criterional attributes within the set criterion and simply ignoring those responses that do not (Galbicka 1994). Reinforcers are said to build behaviours (Vargas 2009) and increases the rate of different sorts of responses (Skinner (1938), but the ignoring part of the process is equally important since extinction initially increases variability (Neuringer 2002) as well as makes responses that have been reinforced previously recur (Epstein 1983). Skinner (1938) also highlights the importance of generalization since it can generate responses that are similar to existing responses, though, outside the reinforced class.

Galbicka (1994) mention two golden rules that are important in the shaping process:

1. Your reinforcement criterion should be a behaviour that exists within the animal's current repertoire.
2. You should have a clear definition of what the terminal behaviour will look like. A clear picture of the different shaping goals will make the trainer confident when the differentiation has been successful.

It seems difficult to study the shaping process, as there are few applied studies that have evaluated and looked more thoroughly into it (Galbicka 1994; Pear and Legris 1987) and even less have evaluated each step in the process. Yin et al. (2008) taught dogs not to jump, bark or crowd at the door when visitors arrived. This was completed with help of a remote-controlled food reward dispenser and a PRT-protocol. The dogs were trained two different down-behaviours with guidance of eleven and five shaping steps, respectively. Ferguson and Rosales-Ruiz (2001) used eight shaping steps to teach horses to be loaded with help of target training and shaping (Ferguson and Rosales-Ruiz 2001).

"*Because learning is a relation between past and present it cannot be directly observed*". (Staddon 1983). When studying the shaping process it is the comparison between the initial and the terminal responses that can be quantitatively measured (Galbicka 1994) and since shaping is done by hand (Peterson 2004) it makes the shaping process difficult to systematically study. One reason for this difficulty lies in the collection of criterion-data, which are suggested to be performed trough two schedules*: percentile schedule* and *fixed-criterion schedule*, respectively (Galbicka 1994). The main difference between these two is how they determine what behaviours that fall within a given criterion (Galbicka 1988). Percentile schedules are more flexible and consider a larger proportion of responses and variables, and especially take into account individual differences (Galbicka 1994). Whereas fixed-criterion schedules, as it name says, works with absolute values and are less flexible. For example, if the trainer will teach an animal to turn around, the fixed criterion schedule would use fixed criterions such as: turning around 90°, turning around 180° etc. This makes it possible to quantify the behaviour with cardinal numbers and standard units. This is possible if the behaviour that the animal performs is independent, but since every new behaviour the animal performs in a shaping process is dependent upon the behaviour done before as well as the reinforcement, which the different behaviours generate, the different behaviours are dependent upon each other. Percentile schedules, instead, therefore uses ordinal measurements, where the following behaviour is compared to the preceding behaviour.

There are of course both pros and cons with them both, well described in the review done by Galbicka (1988). However, Galbicka prefers percentile schedules when working with behaviours in a shaping process, in spite of their complexity, and have described them even more thoroughly in a later review (Galbicka 1994).

Scanning/capturing

If an animal offers a complete behaviour spontaneously, the trainer can reward the animal and by doing that "capture" the behaviour (Alexander et al. 2011). Since no shaping is used when the behaviour was caught it needs to be a behaviour that is already in the animals behavioural repertoire, e.g. commonly captured behaviours is some of the jumps in dolphins (Ramirez 1999).

Prompting

A prompt is an antecedent that helps the subject responds correctly (Vargas 2009). When used correctly it prevents the animal from doing any mistake. They can be of different kinds, e.g. verbal instructions where you orally describe how the behaviour is done, or physical, where you guide the animal to perform the desirable response (Kazdin 2001). The most common prompting techniques when training animals is targeting, luring and modelling (Ramirez 1999), see below.

*Targeting***.** A target can be of any kind as long as it is observable for the animal, e.g. a light or an audio signal (Vargas 2009) or other various objects such as balls, shoehorns and similar (Laule et al. 2003) that is visual to the animal. The desired behaviour is either to move towards the target or to touch it, depending on if you want the target to be used as a tool for the animal to follow, e.g. when training loading of horses (Ferguson and Rosales-Ruiz 2001) or to be remained stationed at, e.g. to enable weighing (McKinley et al. 2003).

*Luring***.** When a reward intentionally is presented before the behaviour has started to get the animal to do the behaviour it is called a lure (Alexander et al. 2011). It can be used to get the animal to look into the right direction, e.g. Smith and Davis (2008) used it to lure the dogs to look at the cone by holding food in front of it, and Alexander et al. (2011) found that luring is the most common way to teach the dog a sit or to get the dog across, or through, an agility obstacle (55% and 56% respectively). Though, luring is associated with problems, see below.

Modelling is when the animal is guided physically, e.g. when a leash is used to guide a dog through, or across, objects (Alexander et al. 2011).

The difference between physical prompts (targets) and lures is that the physical prompts help with completing of an action while lures also provide motivating conditions (Vargas 2009). The risk with lures is that the subject will be dependent of the lure to perform the wanted behaviour even in the future. Another side-effect is that the animal, rather than trying to figure out how to earn the reward just follows the reward. This makes it difficult to later fade the lure. Lures can also turn into consequences of

non-compliance; when the animal does not respond to the cue the inexperienced trainer may use a lure to get the animal's attention. This lure rewards the animal not to pay attention to the trainer and can lead to an increase in non-compliance. Though, in an initial phase and used wisely, a lure can be beneficial, as seen in e.g. Smith and Davis (2008) and when used during classical counter-conditioning (Yin 2004).

Conclusion

When teaching an animal a new behaviour there are several ways to reach the terminal result. Each technique has its own pros and cons, and there are ways to combine these techniques to reach a better result. Above some of the methods used in the animal training community were presented, and of course these methods can be used in many different ways; alone and together, depending on the trainer using them. Below, I will go more thoroughly into what effects that could be expected using the different techniques existing, and at the same time present additional methods to generate new patterns of behaviours.

Effects of different training techniques

Training is about teaching the animal to display behaviour during certain circumstances. To teach the animal different behaviours, trainers have developed different techniques. Hence, the same behaviour can be trained with different methods – all roads lead to Rome. However, the technique used will influence both the animal and the trained behaviour, e.g. how long time it takes to teach the animal the specific behaviour: will it be a smooth short road to Rome or a longer, bumpy one?

Knowledge about what kind of effects the trainer can anticipate when using different training techniques have been evaluated in a handful of papers with a couple of different species: in dogs (Alexander et al. 2011; Herron et al. 2009; Schilder and van der Borg 2004), in primates (Bassett et al. 2003) and in horses (Innes and McBride 2008;

McGreevy and McLean 2007). These articles give a hint of what kind of effects to expect from different techniques.

Training techniques based on aversive elements

The use of aversive stimuli has in earlier studies been proven to produce emotional responses and suppressed responding (Estes and Skinner 1941; Hoffman and Fleshler 1962) and the use of negative reinforcement may also produce **superstitious behaviour**[23] (Aeschleman et al. 2003) as well as when the animal is exposed to aversive events (Ramirez 1999). Though, superstitious behaviours may also arise in connection with positive reinforcement.

Aversive and confrontational training methods, such as direct physical corrections, e.g. hitting the dog, threating the dog, e.g. by growling at it, or to try to mimic species specific dominance behaviours, e.g. so called "alpha rolls", where the dog is placed down on its back and forced to lay there until it is permitted to rise up again etc., has proven to elicit aggressive responses towards the human using it (Herron et al. 2009) and other types of positive punishment has been proven to give an increase in dog-dog aggression (Blackwell et al. 2008; Roll and Unshelm 1997). As mentioned above, Bolles (1970) points out that defence reactions often are connected with punishment. Not knowing what reaction connected with the punishment may give consequences not expected. For instance, Yin (2007) means that you may temporally supress the animal's reaction and at the same time doing that continue exposing the animal to the object it finds uncomfortable. This may result in an animal not knowing what to do: freeze, flee or fight? This confusion, as mentioned above, may result in aggressiveness towards the object involved, e.g. aggression towards the owner or other animals. Other studies have revealed that punishment, vocal and/or physical, was associated with lower obedience and other training problems (Tillung 2006) as well as other problematic behaviours in dogs (Hiby et al. 2004).

[23] Superstitious behaviour are responses that accidentally are connected to the reinforcement, e.g. if a monkey accidentally does a spin at the same time as the trainer delivers food, the monkey might think it was that specific behaviour that made the food appear and will repeat the spin to get more access to food. This could interfere with the training of other behaviours.

All studies listed above have looked into behavioural effects of aversive methods. If instead looking at physiological stress indicators, such as cortisol levels and heart rate, the effects of the aversive training gets even clearer. In a study on hunting beagles one group of dogs were given a shock when they did not obey a pre-trained recall during a hunting situation and another group received the shock as they touched the prey (Schalke et al. 2007). This study suggests that the recall-group were not able to clearly associate the aversive stimulus with their response, and did not learn to predict and control the stressor, which resulted in a considerable increase in the physiological stress indicators. In contrast, the dogs that associated the shock with their own response, since they got the shock at the exact moment they touched the prey, could both control and predict the shock appropriately, and did therefore not get raised levels of cortisol. Their reaction to the shock was to release the prey. Both control and predictability have been proven to be of crucial importance for the animal to be able to cope with stressors (Dess et al. 1983; Weiss 1971). Schalke et al. (2007) suggested that a lack of both leads to a higher risk for the animals to show severe and persistent stress symptoms.

Different kinds of aversive equipment to control animals have been developed, and there are a handful of studies that have evaluated the effects of this equipment. Training with shock collar compared with other "harsh" methods, such as the use of prong collars or physical punishment, not only leads to more stressful dogs during training, the animals were also more stressed outside the training context, implying that the dogs expect an aversive event to happen if the trainer is around (Schilder and van der Borg 2004). Other unwanted associations might be that the dogs learn to associate certain cues with getting a shock. Polsky (1994) has reviewed the use of three different kind of shock collars: a collar which operates manually from a distance with help of a remote-transmitter, an automatic anti bark-collar triggered by the barking of the dog and a boundary training collar also called 'invisible fence'. Besides the advantages of remote control of the punisher as well as how fast a target behaviour could be decreased, he also states the disadvantages of incorrect timing, behavioural regression when no collar was used as well as lesions located on the neck of the dog. Polsky's conclusion is that shock collars should only be used if all other alternatives have been considered and only on case-by-case basis. Further, the results from Schalke et al. (2007) and Schilder and van der Borg (2004) could be used to argue that aversive aids, such as electric collars, should

be deeply considered before use, then used restrictedly and only allowed in strictly specified situations to avoid unwanted side effects, or not used at all. Note, in Sweden electrical shock collars and so called "stackel", a collar with spines closest to the dog's neck that are activated if the dog pulls the leash, are forbidden according to the Swedish legislation (Swedish Board of Agriculture, JO11:2, 2011)

Lee et al. (2007) examined the use of electrical shocks in cattle in order to teach the animals to avoid a feed attractant, but did not systematically study the behavioural effects that the training method brought. However, they describe how heifers tried to run away, indeed one heifer ran through a fence, away from the aversive stimulus. There were also animals ignoring the aversive stimulus, and seemed to "push through" to reach the attractant. They explain this variation in behaviour with different sensitivity to the electric stimulus.

Milder, but non-the less aversive, is the choke collar. A choke collar is designed to tighten around the dog's neck if the owner pulls the leash, and may cause pain and reduced air supply, as the name implies. When choke collars were compared to the use of harnesses in dogs it was revealed that the use of choke collars increased the signals of stress displayed and that the dogs also pulled more on the leash (Benjaminsson 2010).

Predictability has been proven to be of importance when coping with aversive elements and Bassett and Buchanan-Smith (2007) recommend the use of a signal to address negative events. A signal that advertises a punishment is in the animal training community called a **delta signal**[24] (Ramirez 1999). Correctly used the trainer gives the animal a chance to change the undesirable behaviour before getting punished. Under some circumstances it can be successfully used, e.g. Kamolnick et al. (1985) suggested that the training of a dolphin could be improved, and even reducing the animal's stress experience, with a delta signal that informed the dolphin "you are wrong," and that it needed to work harder to get back on track and earn a reinforcer – the threat of negative punishment, i.e. not earning a reinforcer. If positive punishment is used instead of a negative punishment, which was the consequence for the dolphin in the example above, Dess et al. (1983) illustrated that the cortisol level would increase if a dog was given a

[24] Delta signal is a signal that warns of an impending punishment.

shock. In contrast, if the shock was predicted the cortisol level would be significantly lowered compared to an unpredicted shock and Weiss (1971) found that predicted shocks reduced the amount of ulcers. However, it should be noted that also a delta signal is considered aversive and could, if overused, lead to similar results as if a positive punisher is delivered alone, regardless if the signal addresses a positive or a negative punisher (Ramirez 1999).

Important to note is that when working with several animals simultaneously, either the signal needs to be directed to all animals in the group or each animal needs its own individual delta signal, otherwise it can cause unnecessary stress for the other animals that are not the primary target of the signal (Bassett and Buchanan-Smith 2007).

Furthermore, if the unwanted response is immediately reinforced while the punishment is delayed, e.g. chasing a prey instead of obeying a recall (Schalke et al. 2007) it has been revealed that it is the reinforcer alone that controls the response and it will be difficult to decrease the response (Epstein 1984). As Schalke et al. (2007) mention, the dogs could not control their impulse to chase the prey, and it is these impulsive behaviours that are difficult to decrease in frequency and put under self-control with punishment (Epstein 1984). The conclusion is that timing is even more important when working with responses that need self-control.

Another reason to be cautious with the use of punishment is because it is easy for the trainer to start focusing on undesirable responses rather than desired responses, which may lead to frustration and passivity in the animal as it does not know what is expected of it (Ramirez 1999). Punishment can also act reinforcing for the punisher, as behaviours seems to decrease at least in the presence of the punisher, which in turn may spiral into the use of more punishment.

It should be pointed out that the severity of the punishment should also be considered before use. For instance lesions have been detected on dogs wearing shock collars (Polsky 1994) and of course other injuries can appear. In several situations the animal needs to trust the trainer to be able to perform well, or even perform at all. If there is an aversive element in the training this trust might be affected. In the articles mentioned above, aversive elements brings different sorts of aggression problems, both towards

other dogs and towards humans, as well as other behavioural problems listed above. These negative side effects need to be deeply reflected upon. Like Polsky (1994) states "*is it worth the risks?*"

Training techniques based on combined reinforcement training

If the animal receives a reward in addition to the aversive stimulus, the negative impact may be reduced through counter conditioning (McKinley 2004). It has been proven that primates trained with the combination of both negative and positive reinforcement had lower level of cortisol compared to animals that have not been trained at all during capture (Elvidge et al. 1976; Reinhardt 1991).

However, it has also been shown that a combination of positive and negative reinforcement may produce emotional responses, suppressed responding and superstitious behaviours (Murrey 2007). Furthermore, combined reinforcement training gives a complex dynamic compared to when each consequence (negative and positive reinforcement, respectively) is used alone (Hearst and Sidman 1961; Iwata 1987; Murrey 2007) and may lead to an increase of stress responses in comparison with training with only positive reinforcement (Reinhardt 2003). The animal simply does not know if the antecedent will bring a positive or a negative outcome, which makes their situation unclear. This ambiguous effect may also be created when combining these elements in association with a cue, known as **poisoned cues**[25] (Pryor 2002). Horse trainer Kurland (2011) even suggests re-training of the behaviour if it initially has been taught with a combination of consequences. That is, if the old cue has such a negative value for the animal that the performance gets affected in a negative way.

Dettmer et al. (1996) did a study where they looked into how the actual training of primates for capture and venipuncture would affect them by using both positive and negative reinforcement. First they conducted a training phase of seven weeks. During the training phase, blood was drawn one time on average 7 min after capturing. After the seventh week of training they also took a second blood draw 60 min after they recaptured the animals, since they wanted to see how the capture as well as the draw of

[25] Poisoned cues are associated with both aversive and nice consequences.

blood affected the different groups. The first part of the study revealed that the use of combined reinforcement in the first five weeks increased the cortisol levels, but then the levels decreased back to base level in the sixth and seventh week of training. This result suggest that negative reinforcement had a positive effect on the animal's stress levels when looking at the effect in a long-term, but that it had a negative effect in the beginning of the training phase. Seven weeks after the training was conducted the trained group was compared to non-trained animals; the trained group experienced significantly lower cortisol levels compared to the non-trained animals in the first blood sample. The second procedure, with 60 min of waiting before the second sample, revealed that the trained animals had no significant difference in cortisol levels between the first and the second blood drawn, in contrast with the non-trained animals, which showed a significant increase. These results imply that no training at all has more negative impact in the long term compared to training consisting of both positive and negative reinforcement elements.

Studies like those described above (Dettmer et al. 1996) suggest that training with a combination of reinforcement, where the trainer uses negative reinforcement to get the animal to perform a certain behaviour, a behaviour that the animal subsequently getsrewarded for when performing, may also affect the animals negatively. Especially initially for an example, as the cortisol levels increases because of the training (Dettmer et al. 1996).

However, it should also be noted, as the animals experience the training, it becomes less stressful and in the end this training technique, with combined reinforcement, is more beneficial than when naïve or inexperienced animal have not been behaviourally habituated to the procedure at all (Dettmer et al. 1996).

Horse trainers work mainly with negative reinforcement, commonly called pressure-release, where the rider controls the horse with help of the rider's legs and the reins (McGreevy and McLean 2007). The light pressure should act as a discriminative signal to the horse to perform the correct behaviour. If the horse responds correctly to the pressure, the pressure is released. If the horse, however, does not respond correctly, a stronger pressure is added until the horse performs according to the rider's will. If the

negative reinforcer, the pressure, is not used correctly, i.e. pressure is not released when the horse does the correct behaviour, it has been proven to lead to different behavioural problems in the ridden and led horse McGreevy and McLean (2005), cited in McGreevy and McLean (2007), manifested as conflict behaviours that eventually may lead to learned helplessness (McLean and McGreevy (2004) cited in McGreevy and McLean (2007)), e.g. bucking, shying, rearing etc. (McGreevy and McLean 2007).

In Schalke et al. (2007), mentioned above, one of the groups of dogs tested received an electric shock when they did not obey a pre-trained recall. The study revealed that these dogs experienced significantly increased cortisol levels due to their lack of ability to associate the disobedience of the recall with the shock given. The recall, an audio-signal signifying "here", had been trained before the actual experiment but what kind of training method was used to train the recall was not mentioned and sorely lacking. It would also have been interesting to see how and if the recall became affected by the use of electric shocks outside the experimental hunting situation.

Except from the behavioural problems mentioned above that are paired with the use of combined training, e.g. bucking, rearing, learned helplessness, aggression etc., aversive stimuli used in the training process can lead to experiences of fear or anxiety that may inhibit learning (Lieberman 1993). LeDoux (1994) has highlighted that fear responses are more difficult to extinguish compared to other behaviours, which implies that it is important to not provoke or maintain these kind of behaviours. This is of course also applicable for the use of aversive elements alone, and not only in combined training techniques.

Because of the effects mentioned above, the use of combined training should be considered only when alternatives with positive reinforcement alone have been exhausted (Prescott and Buchanan-Smith 2003).

Laule and Desmond (1998) object to the use of combined training where the animal needs to choose between two threatening situations, e.g. go into the squeeze cage or be caught by a net, since that is unlikely to enhance their well-being. However, combined training might be the only option available when capturing untrained animals and perhaps a choice between two aversive elements is better than no choice at all. As

Dettmer et al. (1996) suggested, even if the situation is aversive initially, eventually the animal may learn to cope with the situation and not find it as stressful as in the beginning. With a careful considered training plan with a clear goal and an open mind to changes, combined training can be a successful solution when positive reinforcement training is a difficult alternative.

Training techniques based on positive reinforcement

The use of positive reinforcement alone has been proven to result in the lowest number of undesirable behaviours in dogs (Blackwell et al. 2008; Hiby et al. 2004) and has also been proven to be associated with both higher obedience and trainability (Tillung 2006). Arhant et al. (2010) additionally suggest that the use of positive reinforcements not only leads to less aggressive but also less fearful dogs. The association between less fearfulness and the use of positive reinforcement has also been illustrated by Innes and McBride (2008). They compared the use of negative reinforcement training and positive reinforcement training when rehabilitating horses and found that horses trained with a reward-based strategy were more explorative when encountering situations new for them.

Furthermore, Alexander et al. (2011) found that positive reinforcement training was preferred by the trainers and also associated with performance success in search dog's equipages. However, they also saw that there was a significant increase of compulsive training aids used with the maturation of the dog. In addition, the choice of training methods influenced performance as well as the dogs' concentration and it has been revealed in working dogs that high-performance dogs are exposed to fewer aversive stimuli and are less distracted compared with low-performance dogs (Haverbeke et al. 2008). Of course, it could be argued that high-performance dogs compared with low-performance dogs do not need harsh methods, since they perform well and pay good attention to their handlers. Since training can improve attention skills, as trained dogs are less distracted compared with untrained dogs (Vas et al. 2007) and improve the dog's skill to solve problems and be more proactive (Marshall-Pescini et al. 2008), it could be argued that training in itself increases the attention, and since there is a

positive correlation between attention and dog's disposition to learn and vice versa (Lindsay 2005) it is difficult to pinpoint the precise reason for these results.

Though, it should be noticed that, by previous observations done by the authors outside the range of that study, even the high-performing dogs had been trained with aversive training methods before (Haverbeke et al. 2008).

Alexander et al. (2011) argue for the importance of positive reinforcement training in search dog training since it makes the dog more committed to stay with their target odour. Sometimes the behaviour of the search dog conflicts with the handler's commands, but it is a good sign if the dog disobeys the handler and sticks to its odour. This level of disobedience is welcomed. The handler wants the dog to stay committed to the target odour, no matter what. The dog's willingness to stay committed to a target odour has been suggested to relate to what kind of training it has experienced. Due to this, several bloodhound-trailing handlers only train a minimal of obedience with their dogs, since obedience training is considered to potentially conflict with the performance of the dog's natural skill. I believe this is a theory that should be studied more thoroughly, because if it is – as with the poisoned cues (Pryor 2002) – a complex conflict between the obedience training and the search dog training, where you need to trust the animal's natural skill, it should be emphasised. In a personal communication with Ramirez (2011a), also guide dogs are encouraged to take decisions that might conflict with the handlers command. Since the handler is not able to see i.e. a stick hanging over the trail, a well-trained guide dog will choose a way around the stick, though the handler commands it to walk on straight.

When comparing the response to mildly stressful routine husbandry procedures between trained and non-trained marmosets, where training is not used to execute the procedure, the results implied that trained monkeys cope better with these procedures (Bassett et al. 2003). Several studies have illustrated that physiological changes associated with stress can be reduced with positive reinforcement training in different species, e.g. primates (Lambeth et al. 2006; Reinhardt 1991; Videan et al. 2005) and snow leopards (Savastano 2005). Positive reinforcement training simply allows the animal to choose how they perform behaviours, which increases their control over their

environment, e.g. they can choose not to cooperate (Laule et al. 2003; Laule and Whittaker 2007).

Training with a conditioned reinforcer

The use of a secondary reinforcer is something that has been developed even further within the positive reinforcement training community, where the use of a clicker, or another similar piece of equipment (see below), has become common. A clicker is a conditioned reinforcer that helps the trainer mark the precise moment the animal performs a wanted behaviour (Laule et al. 2003; Pryor 1999; Ramirez 1999) and by doing that instantly informing the animal two things: 1) the behaviour you just did elicited a click and 2) you will be rewarded for that specific behaviour. The use of a conditioned reinforcer enables the trainer to bridge the gap between the desirable response and when the animal receives the reward. Therefore the clicker is also known as a bridge or an event marker.

Different kind of equipment is used as bridges depending on the species or circumstances. For instance, Skinner used a flash when he wanted to document a shaping process in which he taught a dog to jump (Vargas 2009). Whistles are used when training dolphins and clickers are commonly used among animal trainers (Pryor 1999) as well as a verbal "good" (Laule et al. 2003). If the animal is deaf hand signals can be useful (Edberg 2011) and in smaller animals I suggest a pen, which produce a softer sound, to be used, or even a clicking sound produced by the trainer's mouth (McKinley 2004). Irrespective of what kind of equipment trainers use, it should produce a stimulus easy for the animal to perceive, i.e. it should be salient from other stimuli in the animal's surroundings.

It has been stated that secondary reinforcers can enhance the training (Laule et al. 2003), but results studying positive reinforcement training and the use of a bridge has been contradictory. Studies made on horses (Williams et al. 2004) and dogs (Smith and Davis 2008) did not find significant difference between animals which receives a secondary reinforcement followed by the primary reinforcement (food) and those which receive only the primary reinforcement. However, other studies on goats (Langbein et al. 2007), horses (McCall and Burgin 2002) and a variety of laboratory animals (Baxter et

al. 1999; Egger and Miller 1962; Zimmerman 1957) have proven that secondary reinforcement do facilitate operant learning tasks.

It should be pointed out that though both Williams et al. (2004) and Smith and Davis (2008) could not see that the use of a conditioned reinforcer could enhance the training they did see that the behaviours being paired with a conditioned reinforcer were less sensitive to extinction. One explanation to the contradictory results could be the five seconds delay between the bridge and the primary reinforcement that the authors (Williams et al. 2004) used. Delays have been confirmed to make it harder for the animal to establish an association between the operant behaviour and reinforcement (Mazur 1997). It could also be, as Smith and Davis (2008) suggest in their discussion, that the hand movement in the control group acts as a marker similar to the clicker, and that is the reason why there are no differences between the two groups. Why there were a difference in sensitivity to extinction could be explained by the salient sound of the clicker, further discussed below.

Physiological reasons why training with secondary reinforcers work

Looking more thoroughly into the literature there is evidence that describes why and how a secondary reinforcers could improve training.

When looking at the psychological mechanisms of conditioned reinforcers, classical fear conditioning experiments, where sounds are paired with shocks, have been used. The fear stimuli have in these experiments been shown to go directly to the amygdala, causing direct emotional responses, even before the complete understanding and feeling of the event (LeDoux 1994). In parallel, the message goes to regions where emotional and declarative memories are stored. In a more or less similar way does the conditioned reinforcer work (Cardinal et al. 2002). Because of this instant connection, Pryor (1999) suggests that this could be one reason why clicker training is believed to create both strong emotions and instant memories.

Another important factor in the early stages of learning is the release of dopamine, since the achievement as well as the expression of learned responses is mediated by dopamine (Horvitz et al. 2007). Dopamine plays the role of a "*good parent*", who in the

beginning encourages the learned behaviours and later on lets the behaviour perform by its own. This means that dopamine released during the 'outcome-mediation' could be considered to improve training and that this release is something that trainers should try to trigger.

Furthermore, the effects of conditioned reinforcers are associated with dopamine releases (Ikemoto and Panksepp 1999). It has been shown that dopamine releases are triggered by salient events, such as distinct clicks or light flashes (Horvitz et al. 2007), which is exactly what is used in clicker training. A clicker's, or other commonly used marker signal's, salient and sharp nature could therefore be another explanation why clicker training is believed to improve training – they simply trigger a dopamine release.

But, it is not only the conditioned reinforcer, or the primary reinforcer, per se that can trigger this release of dopamine; it has also been found that the 'expectation' of a reward has the same effect (Schultz 1998). When studying the anticipation more concretely, Kamal et al. (2010) saw that when socially stressed rats not only received enriched housing – enriched housing is considered to be highly rewarding for rats (van der Harst et al. 2003) – but also got the enriched housing announced, the deterioration stress effects were significantly reversed. Whatever reward works as long as it is something the animal wants. It could be argued that the actual anticipation of a reward when using a secondary reinforcer would improve training as well.

Another factor activated by secondary reinforcement that can affect training is one of the core emotions described by Panksepp[26]: the SEEKING system[27] (Panksepp 2005). This emotional action system helps the animal to activate its life-sustaining resources, which makes it e.g. more explorative. To survive, the animal needs to be aware of the signals of its surroundings telling the animal for instance where to find food. Therefore the SEEKING system is especially easily activated by signals that predict rewards, which is what conditioned reinforcers do (Westlund 2012). This implies that animals trained

[26] Panksepp's system of emotions involves seven core-emotional feelings found in both humans and animals. The other six are RAGE, LUST; CARE; PANIC, FEAR and PLAY, all of which affects each other in different ways.
[27] The SEEKING system, one of Panksepp´s seven key emotions, is an energizing function of the brain's involving both expectancy and wanting.

with conditioned reinforcers get more explorative during the training session, which is commonly seen as a good quality when training animals.

There are different ways to reinforce correct behaviours in positive reinforcement training; different kind of food is most commonly used in zoo and laboratory animals. But also play could be used as a reinforcer, which for instance Ramirez (1999) does and advices others to do as well. In dog training playing is an important part of the reinforcement resources that can be used. Play, where the dog both wins and loses the tug-of-war game, has been shown to have high scores in attentiveness when training obedience, and if really playful dogs were allowed to win the game their play attention seeking were significantly higher compared to when they lost the game (Rooney and Bradshaw 2002). From this we may conclude that play could be a more used resource also in other animal training situations, especially if there is a problem with obesity in the animal being trained. However, the trainer needs to make a decision if the species she or he works with can be trained with help of play. Ramirez (1999) also point out that a variation of reinforcers, both different kinds of food as well as different kinds of toys and physical contacts, could enhance the training performance as the training gets an element of surprise that could lead to an increase of attention from the animal. This knowledge, about the use of more than just food as a reinforcement resource, together with the fact that the expectation of a reward triggers dopamine releases (Schultz 1998), could tell us that the knowing of a reward coming but not knowing which kind could lead to an increase in attention, which secondly could lead to an increase in training performance. As Sapolsky (2009) says in a talk about dopamine effects: "*take a monkey, and there's nothing more addictive than the notion that there is a reward lurking out there – and it's a maybe*".

Reducing unwanted behaviour

When trainers want to control unwanted behaviours many people's first thought is to use different kind of punishment. But there are other techniques that can be used when dealing with undesirable behaviours. Arhant et al. (2010) found two reward-based responses that owners use if their dogs perform an unwanted behaviour: distracting with food/play or comforting the dog with petting/speaking. Other techniques used in the animal training community are Time Out, LRS, extinction (all described above), and

also **Non-contingent reinforcement**[28] and the differential reinforcement techniques existing: **Differential Reinforcement of Incompatible behaviour**[29] and **Differential Reinforcement of Other behaviour**[30], **Differential Reinforcement of Alternative behaviour**[31] (Turner and Tompkins 1990) and **Differential Reinforcement of Low-rates**[32] (Kramer and Rilling 1970).

Non-contingent reinforcement (NCR), reinforcing any behaviour the animal does, independent of what response it shows (Vollmer et al. 1993). By putting the reinforcement on a fixed-time schedule, the trainer can assure that the reinforcement delivered is not influenced of the animal's behaviour. NCR could be used for instance during crate training (Blake 2009), where the animal seeks attention from its owner by attention seeking behaviours such as barking or whining. If the trainer through the use of NCR can eliminate the social deprivation crate training creates, the attention seeking behaviour of the animal will decrease successively.

Differential Reinforcement of Incompatible behaviour (*DRI)*, by reinforcing a behaviour that is incompatible with the unwanted behaviour the trainer can get control over the unwanted behaviour (Turner and Tompkins 1990). If there for instance is a monkey that tries to escape every time the gate opens, the trainer can reinforce the monkey to stay in the other end of the cage when entering, which is incompatible with escaping. As the monkey gets rewarded for staying away this behaviour will increase in frequency and at the same time the attempt to escape decreases.

[28] Non-contingent reinforcement (NCR), a response-independent reinforcing procedure, which could be put on a fixed-time schedule to ensure that it is not influenced by the animal's behaviour.
[29] Differential Reinforcement of Incompatible behaviour (DRI), reinforcing the animal for doing a behaviour incompatible with the unwanted behaviour.
[30] Differential Reinforcement of Other behaviour (DRO), reinforcing the animal for not doing an unwanted behaviour.
[31] Differential Reinforcement of Alternative behaviour (DRA) is when the trainer always reinforces alternative behaviour, not incompatible as in DRI, and completely ignoring the unwanted behaviour.
[32] Differential Reinforcement of Low-rates (DRL), reinforcing the animal for not doing a specific behaviour but the trainer can also reinforce the actually unwanted behaviour if the animal has managed to wait until a certain time interval is finished.

Differential Reinforcement of Other behaviour (DRO) or *Omission training* is when the subject receives a reward for **not** doing a specific behaviour (Vollmer et al. 1993). This technique is for instance used in humans with self-injury behaviours (SIB) problems, where they are rewarded for not performing SIB under a certain time interval. It could of course also be used in animals, e.g. in stationing training if there is a problem with animals that leave their locations. The trainer simply rewards the animal for not leaving its station within a set time interval. To work, the DRO-interval should be implemented within the timeframe just before the animal starts exposing restlessness and goes away. By reinforcing just *before* this happens, the behaviour of staying will be prolonged gradually.

Differential Reinforcement of Alternative behaviour (DRA) is when the trainer always reinforces alternative behaviour, not incompatible as in DRI, and completely ignoring the unwanted behaviour (extinction) (Vollmer et al. 1999). As the alternative behaviour is reinforced it will become a more preferable behaviour for the subject compared to the behaviour that is ignored. For an example, if a cat always seeks attention by scratching the owner's leg, the owner can ignore that behaviour and instead give the cat attention (reinforcement) when it seeks attention in a more desirable way, e.g. by meowing.

Differential Reinforcement of Low-rates (DRL) is similar to DRO as it is also works under a time interval, where the subject are reinforced for **not** doing the behaviour. However, when using the DRL you actually reinforce the unwanted behaviour when it occurs, but you only reinforce it if the subject has managed to wait until a certain time interval is finished. It is a technique used when the behaviour is wanted, but not in as high frequency as the subject performs it, for example in Obsessive Compulsive Disorders (OCD) (March 1995). In OCD the subject for instance washes his hands too often. The subject then gets a timeframe of e.g. 10 min. If he manages not to wash his hands during that time interval he gets rewarded. The time interval is prolonged successively until a "normal" frequency is reached.

As with most training techniques, strategies influence each other and a combination of different differential reinforcement techniques can make the training even more effective (Turner and Tompkins 1990). And as with most training strategies, a well-

considered training plan and analysis of the situation is the best way to succeed and manage to control the unwanted behaviour.

Conclusion

I believe there is a need to study the different training methods presented in additional contexts to be able to say that one method is better than another. There are as many methods as trainers and as many results that there is situations. Trainers are also often affected by external variables, such as time, economy and other resources, which maybe also need to be taken into considerations when studying these questions.

My conclusion is, though, that training with positive reinforcement elements is, according to the studies presented above, the method that gives most positive outcomes in forms of efficiency, ethical considerations and for the welfare of the animal.

Summary conclusion

There are several methods to reach the very same goal. However, they differ in efficiency, performance success and ethical considerations, which makes it important for the animal trainer to thoroughly plan and think before doing the actual training of the animal. What does the behaviour I want look like? In what mental state do I want the animal to be in when it performs that behaviour? Under which circumstances will the animal perform the behaviour? Etc.

By combining the theory behind the learning processes with different studies about which effects to expect when using different training methods, I have tried to give myself and the reader more knowledge about how to become a better animal trainer. By using the theory of learning, the knowledge about the techniques that exists and common sense we have all the chance to succeed when we want to teach an animal a new behaviour.

Glossary

Antecedents are stimuli, contexts or settings that occur before the behaviour and influence the action of it.

Classical conditioning, describes responses that are automatic to a stimulus.
Counter conditioning is an active desensitization technique where habituation and an association process are combined.

Delta signal is a signal that warns of an impending punishment.
Desensitization is a process in which the animal's perception of a certain event is changed to a more neutral response.
Differential Reinforcement of Alternative behaviour (DRA) is when the trainer always reinforces alternative behaviour, not incompatible as in DRI, and completely ignoring the unwanted behaviour.
Differential Reinforcement of Incompatible behaviour (DRI), reinforcing the animal for doing an behaviour incompatible with the unwanted behaviour
Differential Reinforcement of Low-rates (DRL), reinforcing the animal for not doing a specific behaviour but the trainer can also reinforcing the actual unwanted behaviour if the animal has managed to wait until a certain time interval is finished.
Differential Reinforcement of Other behaviour (DRO), reinforcing the animal for not doing a specific behaviour.

Elicited behaviours are controlled by stimuli that precede them.
Emitted behaviours are dependent and controlled upon earlier experience of the outcome of that response, i.e. their relation to postcedents.
Extinction is when reinforcements that have maintained a specific response diminish or disappear and the behaviour it has reinforced will stop.
Extinction burst is an increase in the force or frequency of action and happens before responses under extinction decline.

Habituation, the decline in responsiveness to a stimulus when repeatedly exposed to it.

Negative punishment, when a stimulus taken away/reduced results in a reduction of the behaviour.
Negative reinforcement, when a stimulus reduced/taken away increases the probability for that response to occur again.
Non-contingent reinforcement (NCR), a response-independent reinforcing procedure which could be put on a fixed-time schedule to ensure that it is not influenced on the animal's behaviour.

Operant conditioning, describes behaviours controlled by their consequences.

Panksepp's system of emotions involve seven core-emotional feelings found in both humans and animals. The other seven are RAGE, LUST; CARE; PANIC, FEAR and PLAY, all of which affects each other in different ways.
Poisoned cues are associated with both aversive and nice consequences.

Positive punishment, when a stimulus added results in a reduction of the affected behaviour.
Positive reinforcement, when a stimulus added increases the probability for that response to occur again.
Positive Reinforcement Training (PRT) is a training technique in which animals are rewarded when performing desirable behaviours.
Postcedents are what follow the action of the behaviour.
Primary reinforcers are inherently rewarding for the animal.

Respondent behaviours can be explained as responses to stimuli as a part of a reflex.

The SEEKING system, one of Panksepp´s seven core emotions, is an energizing function of the brain's involving both expectancy and wanting.
Secondary or conditioned reinforcer, a stimulus that has been paired with an existing reinforcer until
it becomes a reinforcer itself.
Sensitization, the increase in responsiveness to a stimulus when exposed to it repeatedly.
Shaping is a training process in which the trainer differential reinforces changes, i.e. intensity or direction, in an animal's existing behaviour and gradually guides the animal's behaviour into a new behaviour.
Superstitious behaviour are responses that only have accidental connection to the appearance of a reinforcer, e.g. if a monkey accidentally does a spin at
the same time as the trainer delivers food, the monkey might think it was that specific behaviour that made the food appear and will repeat the spin to get more access to food. This could interfere with the training of other behaviours.
Systematic desensitization is when the subject is gradually exposed to the aversive stimulus, always below threshold for the response, to enable the subject to gradually get used to it.

Tertiary reinforcer, a stimulus, such as a cue, associated with a secondary reinforcement .
Time out is a negative punisher that takes away the opportunity for the animal to earn a positive reinforcer.

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