Review paper

Is there an optimal approach for training the domestic dog (*Canis familiaris*)?

Empirical study

An investigation into the Drevers' potential as a breed of mine detection dog. A field study to compare the behaviour of two breeds of dog during training for landmine detection.

by

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Abstract

Man's relationship with the dog dates back over a hundred thousand years. Throughout this period, training has been, and remains, an integral part of the human-canine bond. Training is based on the establishment of conditioned associations, thus an understanding of learning theory plays an important role in developing suitable training techniques.

With regards to dog training, the three most viable options available are punishment, negative reinforcement and positive reinforcement. The use of punishment has become less common, possibly due to changes in moral stance. Its efficiency is still greatly debated. In contrast, methods utilising reinforcement have become more widely accepted in recent years. Nevertheless, there is still little scientific data to validate their efficiency as training methods.

In the last decade, papers investigating less conventional approaches towards training have appeared in the scientific literature. These provide evidence in favour of potential alternatives to the regularly accepted methods. However, at present, these indications are based on one-off studies and further research would be needed to substantiate the evidence they provide.

Although many weighted opinions on the optimal approach to adopt when training dogs are expressed, they are effectively based on personal experience and are not supported with sufficient data. Well-balanced studies of dogs' responses to a range of training methods would therefore be beneficial. The ethics of using punishment in such experiments may be disputed.

Keywords: *dog training*, *learning theory, positive reinforcement, negative reinforcement, punishment*

1. Introduction

Man's affiliation with the dog dates back 135,000 years (Wayne and Ostrander, 1999). Since then, there have been considerable changes in society and as a result, our

relationship with dogs has altered dramatically. Many breeds of dog were originally bred to work, but now many are kept solely as companions. In spite of this, dogs still need ample physical and mental stimulation to prevent behavioural problems. Training is one way to occupy a dog's mind (Holden and White, 1999). Training can be defined as

> "purposefully modifying the behaviour of another species to make it a more compatible and cooperative companion and helper" (Lindsay, 2001).

Training is an integral part of the human-canine relationship and it is imperative for safeguarding our control.

People can train animals using various methods and there are an array of views regarding which is the best approach to adopt. Many training methods are based on tradition (Farmer-Dougan and Dougan, 1999) and as such, there is great resistance to change. However, in recent years, attitudes towards the training of dogs have begun to change (Fisher, 1992). The change in attitude may have arisen as a consequence of a greater awareness of dogs' needs but it is believed to have been pushed to the forefront by the changed perception of dogs (Fisher, 1992). Our often over indulgent attitudes towards dogs conflicts with the older, more forceful methods that worked on the basis that the dog understood it was lowest in the hierarchy. This altered perception has resulted in more behavioural problems (Kelsey-Wood, 1997) and thus, a need for an updated approach to training.

Although there is evidence from early times that training occurred, there are no records of what methods were used (Lindsay, 2001). There are indications though that many of the theories that are widely accepted today were recognised centuries ago (Xenophon, 1925/1984; Most, 1910/1955). Training techniques were first recorded around the time of World War I (Fisher, 1992). The traditional view of dog owners and trainers was 'you dog, I master, I say, you do' (Fisher, 1995). These methods were based on alternations between praise and punishment and relied greatly on repetition. There is no denying that dogs were successfully trained this way and several people still rely heavily on punishment (Fisher, 1991), but there are now known alternatives available. This paper aims to evaluate the evidence in favour of each available training technique and draw conclusions on the optimal approach for training the domestic dog.

2. How dogs learn

Our view of animals and their expectations are often marred by their portrayal as human-like characters in Disney films e.g. Lassie. Such anthropomorphism is the root of many misconceptions in training (Edwards, 1977). Humans rely on verbal language to communicate (Pryor, 1999) whereas animals commonly use a more behaviourally based language for communication. Dogs do not understand language in the same way humans do, they merely learn to associate sounds and intonations with certain actions (Holmes, 1991).

Training methods have to be suited to the way in which dogs' mind work. Dogs do not contemplate the future in the same way as humans are able to and as such, they only exist from moment to moment (Kelsey-Wood, 1997). Dogs, typically, learn by trial and error (Ross and McKinney, 1992). Their learning is based on the establishment of associations between their action and the outcome, the outcome either being pleasant or unpleasant (Holmes, 1991). To assess the learning outcome, and thus the success of a training method, the strength of the association should be considered. An animal is believed to have learned the association when few responsive errors are displayed, and its responses are fast, strong, immediate and consistent. The process by which animals acquire new behaviour patterns that are not instinctive is summated by learning theory (O'Farrell, 1992). An understanding of learning theory is paramount in the search for the most effective way to train dogs.

Of the five fundamental types of learning, operant conditioning is that most commonly used for dog training (O'Farrell, 1992). Operant conditioning involves the dog performing a voluntary action and being reinforced for doing so. Moreover, all training methods involve the pairing of a stimulus with a response. A stimulus and response can be paired by reinforcement or by punishment. Reinforcement increases the likelihood of the behaviour occurring and punishment decreases it. Reinforcers can be either positive (something the animal wants e.g. food) or negative (something the animal wants to avoid e.g. electric shock). Negative reinforcement is based on the idea that an animal elicits a response so as to avoid the aversive stimulus (Lindsay, 2001). In contrast, punishment and positive reinforcement are applied when the animal makes a response. Typically, if the response is undesired, punishment is used whereas if the response is to be encouraged positive reinforcement will be used (Skinner, 1953). The use of the terms negative reinforcement and punishment are often referred to interchangeably in the literature which can be confusing.

3. Punishment

Of all the available training techniques, punishment is the most routinely debated. The overall aim of punishment is to stop a behaviour (O'Farrell, 1992). Effects of punishment seem to be reliant on so many variables that its effectiveness is difficult to quantify.

Standard training methods often rely on punishment, e.g. horse-breaking (Farmer-Dougan and Dougan, 1999), and the use of punishment is still the norm in many dog-training clubs (Fisher, 1993). The principal argument used against punishment by modern trainers is that it does not teach the animal what is right, it only teaches it what is wrong (Pryor, 1999; Peace and Bayley, 2001), and some even profess that it does not teach the animal anything (Fisher, 1995; Mills, 1997; Baer, 1999). This is not necessarily the case, as by punishing all incorrect responses (Bolles, 1973) and as such blocking other available options the correct response may be chanced upon as quickly as with positive-based methods.

Lindsay (2000) proposed several positive side-effects of using punishment – improved social behaviour, increased emotional responsiveness, increase in appropriate play and improved attentional behaviour. It is not clear which species is being referred to however and the author failed to cite any studies to support this.

There is no clear stance on whether punishment increases or decreases the rate of learning. If punishment is used following an incorrect response rather than merely non-reward then learning rate is greater in the punished group (Warden and Aylesworth, 1927). A contrasting study indicated that administration of punishment on a random basis reduced the rate of learning (Overmeir and Seligman, 1967). The alternative methods of delivering punishment are likely more important than the actual use of punishment. The differences in application aside, these studies were based on different species, the former on rats and the latter on dogs. There are several instinctive differences between these two species, especially in fear responses, which may make studies based on rats of limited use with respect to dogs' learning.

Punishment commonly loses its effect because of improper and inconsistent application. It is often used as a means of releasing frustration (Sauter and Glover, 1978) rather than a carefully thought out training lesson. Several undesirable effects can emerge as the result of punishment.

The use of strong aversive stimuli can often leave subjects overly sensitive, to noise for example (Bishop and Morgan-Jones, 1982). However, the sensitisation effects of punishment are also debatable. In some cases, sensitivity is seen to increase with continued use of punishment (Rachlin, 1966; Crosbie et al., 1997) but punishment can also have the opposite effect in that animals become immune to its effects with continued use e.g. the appearance of learned helplessness.

When the punisher is not available, the animal may not perform the desired behaviour e.g. when the dog is off the lead some distance from the punishing owner, it may disobey due to the absence of the aversive (Pryor, 1999). This is because any behaviour that decreases the chance of being punished is reinforced (Skinner, 1953). The effect of absence of the punisher was demonstrated by Azrin and Holz (1966) using a two-component schedule in which responses during one component were punished. This resulted in responses being suppressed during this component but in the non-punishment component the responses returned to previous levels. Unfortunately, this study only involved one subject so does not provide definitive evidence.

If the owner is associated with the punishment, the dog may become frightened of, or aggressive toward, the owner (Fisher, 1993). A study by Roll and Unshelm (1997) found a correlation between the amount of aggression exhibited by the dog and the way in which its owner had trained it. The experimenters used a thorough questionnaire of 206 owners to identify the factors that influenced aggression in dogs. Significantly more dogs that were trained using punishment, e.g. hitting, were instigators of fights. The number of aggressors in the study was three times less than the number of victims so the representative populations in each group were not necessarily equivalents.

Training animals using punishment means that the animal may do what is asked but will not offer behaviours voluntarily and animals may even stop responding because they consider this the safest option (Pryor, 1999). This idea is further supported by an experiment carried out by Crosbie and colleagues (1997) which showed that the use of punishment in pigeons increased the number of responses that were ‘subcriterion’, thus they could not be determined as correct or incorrect. This was thought to have been an attempt to avoid punishment, but it could have been equally due to lack of motivation caused by being punished so regularly. The paper only states that there was an increase, and no specific numbers of the magnitude of the effect are given.

So, when is punishment effective and in what form? The effectiveness will depend on the animal involved, its experience and individuality. Many owners on returning

home punish their dog for an act committed several hours before. Dogs have short memory spans (approximately 0.5 seconds) and so fail to understand that the punishment they are receiving now is a result of something done hours before.

Studies investigating the timing of punishment on learning outcome have shown that the longer the time lapse between the response and the subsequent punishment the less effective the punishment is in suppressing the response. Solomon et al. (1968) subjected 18 purebred beagles to one of three punishment treatments and found the 'no delay' group had the highest resistance to temptation. The resistance of the group with a 15-second delay between their response and the subsequent punishment, was lower in comparison, although it was still high considering the dogs had been starved for two days pre-trial. This study provides evidence that punishment can have durable effects on dogs. One side-effect noted from this study was that all dogs became hesitant to eat anything in the experimental room and emphasises the situation specific component of punishment as well as the stress it can cause.

The results of this experiment may be breed dependent. Scott and Fuller (1965) carried out an investigation into breed differences, where all dogs were reared in a controlled environment, and they found that breeds differed in their reactions to punishment. Therefore, such clear-cut results might not be acquired with an alternative breed. In addition, three of the dogs in each group had been reared in isolation. Although, the dogs were spread equally across the three groups no statistics were done to ensure that there were no differences between these dogs and the remaining three dogs within each group.

With regards to dog training, punishment is said to have the greatest effect when it is applied suddenly (Pryor, 1999), with sufficient strength (Mills, 1997), consistently (Kelsey-Wood, 1997), is not obviously connected with the owner (Fisher, 1995) and is given immediately following the behaviour (Lichtenstein, 1950). Only one of these proposed features is actually supported by a scientific study on the response of dogs, that of Lichtenstein (1950).

A problem with the majority of the evidence for and against the use of punishment is that it is based on experiments carried out in strictly controlled environments and the observed effects would not necessarily transfer to the practical training situation, in which there are several external variables influencing the dog's behaviour at any one moment. In addition, the responses of rats and pigeons are not necessarily similar to those of dogs in similar situations but most of the scientific research into learning theory

in animals is based on these two species. Moreover, aspects such as sufficient strength although easily controlled in a laboratory are not easily gauged in practice.

Although, less common now, some authors consider physical punishment necessary to get quick results:

"A good thump in the ribs with the clenched fist while you pull him up to you, glaring at him, often serves to drive the lesson home" (Holmes, 1991).

Physical punishment can be cruel because it is often through a lack of understanding that the dog fails to obey. Verbal corrections are now suggested as a kinder form of punishment (Baer, 1999). To determine their effectiveness a comparison between physical and verbal correction in a standardised training situation would be required. An experiment carried out by Thorndike (1931) on humans found that reinforcing with the word 'right' strengthened responses but using the word 'wrong' did not weaken them. As previously mentioned, dogs learn differently from humans so this result may not be equally applicable to both species.

Conflicting views within dog training circles remain concerning the use of punishment. Ross and McKinney (1992) and Kelsey-Wood (1997) state that punishment is necessary, and that lack of punishment is the root of many problems. Holmes (1991) agrees that as long as the dog understands the reason for the punishment it is acceptable to use it, even if severe. Instead of physical punishment, White and Evans (1981) suggest that trainers use their intelligence to punish the dog. Several authors advocate punishment only under particular circumstances (Holmes, 1991; Holden and White, 1999; Lindsay, 2000) and many feel that punishment is outdated and should be replaced with positive methods (Sauter and Glover, 1978; O'Farrell, 1992; Mills, 1997; Pryor, 1999). However, all these opinions are based on personal experience and few, if any, are substantiated by scientific studies.

4. Reinforcement

Initial training using reinforcement relies on continual reinforcement for correct responses but this can be decreased to an intermittent schedule once the behaviour is learned. Changing to an intermittent schedule can often improve the animal's response (Fisher, 1992) because they try harder to ensure reward. Studies have shown that the response rate is proportional to that of reinforcement (Herrnstein, 1970). Nevertheless, overuse of rewards can cause animals to lose interest. Pryor (1999) states that the

maximum number of reinforcers that can retain a subject's interest is eighty. However, in experimental psychology, animals work for many more rewards; shaping programmes can involve the subjects working for 130 rewards in one session (Weiss et al., 1993). On the other hand, the motivation of these subjects is high because they are maintained at 80% of their free-feeding weight. Ethically, it would not be acceptable to use a similar technique to train dogs.

The timing of reinforcement is crucial; this is also true of punishment (O'Farrell, 1992). Both should be presented in contiguity with the response for full effectiveness. Novice trainers often struggle to reinforce at the correct time (Pryor, 1999) and the dog has often changed behaviour by the time the reward is given. This emphasises the difference in applying learning theory in practice in comparison with laboratory situations where timing is computer-controlled.

Many trainers have now adopted a positive approach to training. Positive reinforcement is based on the proviso that the dog will repeat a behaviour if it found it rewarding to perform (Fisher, 1993). Rewarding correct behaviour and ignoring wrong behaviour is believed to make the dog think for itself (Pryor, 1999). Allowing active learning is claimed to help the dog remember the desired behaviours more efficiently than when aversive methods are used (O'Farrell, 1992).

Conventionally in dog training trainers give the command and then force the behaviour, normally by applying an aversive stimulus (Kaplan et al., 2002). The animal learns to respond to the command to avoid the aversive (Holmes, 1991) and thus, the procedure is one of negative reinforcement. Negative reinforcement works on the same criteria as positive reinforcement, only the dog associates the aversive with its own behaviour. Aversives that exploit the startle effect, such as Dog Training Discs (Fisher, 1995), prevent the dog from associating the aversive with the owner. By encouraging the dog into another behaviour simultaneously, the dog's learning is furthered. Informal research on Dog Training Discs by Fisher (1995) concluded that for the technique to work the startling noise has to be unique to instances of unwanted behaviours.

Other such methods that take advantage of self-reinforcement have been suggested; one being that of autotraining (Coren, 2000), which allows the dog to associate voluntary behaviours with spoken commands, resulting in the dog gaining a clearer understanding of the meaning of the commands. However, this system, as with all positive reinforcement methods, is dependent on the behaviour occurring (Pryor, 1999). Hence, it may not be very useful for complex or rare behaviours.

Although punishment can speed up the rate of learning, several authors believe that positive reinforcement is a more productive method (Holmes, 1991; Mugford, 1992; Baer, 1999; Dennis, 1999; Farmer-Dougan and Dougan, 1999; Pryor, 1999). One increasingly popular method of positive reinforcement training that reportedly results in accelerated learning is that of clicker training (Pryor, 1999). Clicker training involves the use of a conditioned reinforcer to bridge the gap in time before the primary reinforcer is presented (Voith and Borchelt, 1996). As with previously discussed methods of positive reinforcement, clicker training allows the animal to experiment without being punished and thus supports the animal thinking independently. This reportedly results in a better rate of retention but there are no scientific studies of dogs to support this (Pryor, pers. comm.). Additionally, assertions that clicker training is very effective in a large range of animals (Kaplan et al., 2002) have yet to be supported with strong scientific facts. Apparently, if the two methods of clicking and correction are combined the rate of learning drops and learning may stop altogether (Pryor, 1999). This, again, is based on observation and would need substantiated by a controlled study.

5. Modern approaches to training

In the last few years, various control measures based on exploiting animals' natural ecology have been documented (Roberts, 1996; Fennell, 2000). These methods are criticised for their lack of scientific basis. Despite this, their popularity within the public domain has increased and this may reflect the acceptance of more unconventional methods into the dog-training world.

Other similarly atypical attempts to train dogs have been documented. Slabbert and Rasa (1997) attempted to teach puppies how to search for narcotics by allowing them to observe their mother working. Observing their mother improved their performance on the search tasks compared with non-exposed puppies ($p<0.001$), with 85% of the puppies ($n=20$) that had observed their mother retrieving scoring higher than the criterion value and 20% achieving scores equal to those required of fully trained narcotics dogs. Unfortunately, the assigned scores were based on subjective criteria and the results could have been made more reliable by also recording objective measures e.g. time taken to retrieve the sachet. The result of the study is no doubt impressive with regards to the increased rate of production it could have within working dog centres if it was found to have equally significant results on replication.

McKinley and Young (2003) used a similarly unusual technique to teach dogs a retrieval task. The dogs were trained to perform the task using both operant conditioning and the model-rival technique outlined by Pepperberg (1990). No difference was found between the two methods for the time taken to complete the task. The individual differences in times taken to complete the task override any effect of the training techniques. The sample contained nine dogs of different ages, breeds and backgrounds, and these factors are known to have considerable effects on an animal's responses. There is no mention in the paper of the delay between the training and the trials, therefore there is no information on the temporal aspects as regards the effects of the technique. Furthermore, using the same dogs for both methods meant there could have been a crossover effect depending on which method was used first.

The model-rival technique has proved extremely successful with Alex, an African Grey parrot (Pepperberg, 1990). Alex's close relationship with the trainer is thought to be highly influential to his co-operation. Therefore, the use of this technique could be greatly influenced by the person training the dog. In this study, the experimenters were unknown to the dogs. The results for the model-rival technique may have been greatly improved if, instead, the owners had trained the dogs. This should be considered in future studies.

An earlier study by Young (1991) investigating dogs' abilities to discriminate verbal commands utilised a similar approach to that of the operant conditioning technique of McKinley and Young (2003). In this experiment, dogs were taught to associate three items each with a specific word and in trials requested to retrieve one item from the three. All dogs achieved over 80% correct retrieves on first asking showing that they could learn to associate different words with different objects reliably. More interestingly, it was noted that words similar in sound were more often confused, shown by a greater number of errors in trials involving similar words. As such, phonetics should be taken into consideration when teaching verbal commands. Comparison between the studies is not possible because in Young's study, only percentages of correct responses were recorded and no temporal data is available.

6. Individual and breed differences

Several factors influence a dog's response to training, irrespective of the approach. Problems arise because dogs are often trained in the same way regardless of breed, age and experience (Myles, 1991). Experience affects the animal's ability to learn

(Huntingford and Wright, 1992) and further learning is more difficult if the animal has already formed habits (Sauter and Glover, 1978).

Furthermore, individuals will react differently to the same method depending on their temperament. Dogs differ in confidence (Ross and McKinney, 1992) and certain degrees of punishment may frighten one dog and have no effect on another. The same effects might be found with positive reinforcement when exceptionally greedy dogs become so fixated on the food reward that they fail to concentrate on what is being asked. Scott and Charles (1954) found that puppies of distinct breeds differed in their reaction to the same stimuli and that the difference between the breeds increased with further training. However, there was no control population to evaluate whether this was an effect of maturity rather than of training.

Dogs also differ in their learning ability for different tasks and are motivated by different things (Holmes, 1991). This is mainly because of breed differences. Specific breeds were originally bred to fulfil specific functions and if the particular task is related to that function, individuals of that breed will learn more quickly than those of other breeds (Pryor, 1999). This is supported by Fuller's study (1955), which found that the performance of breeds on set tasks alternated depending on the task. This is believed to be a direct effect of genetics because these dogs were raised in a controlled environment. However, in this study, and in that of Scott and Charles (1954), several of the experimental measures used were subjective scores so there is the possibility of experimenter bias within the results.

7. Conclusion

The use of punishment is declining in favour of methods employing reinforcement. This is likely to be because applying aversives using negative reinforcement, and allowing the dog to associate its own actions with the outcome, is more effective in teaching the animal something rather than merely stopping the unwanted behaviour. Punishment is also highly dependable on correct application and this is not necessarily achievable by the majority of lay-people.

Reward based methods have the advantage that they benefit the dog as well as the owner. Although not supported as yet by substantial scientific data, nearly all modern training manuals promote positive reinforcement, so it is likely that the increased prevalence of this method is warranted. Standardised studies investigating dogs'

responses to this method would be beneficial to enhancing scientific knowledge in this area.

Studies of less conventional approaches indicate their potential for further use but they are based on single experiments and would need to be sufficiently replicated to prove their credibility.

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A field study to compare the behaviour of two breeds of dog during training for landmine detection

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Abstract

The use of dogs for landmine detection is an expanding industry. Its recent development has prompted more research into the capabilities of mine detection dogs and in particular, investigation into the most suitable breeds of dog to use. Most operational mine detection dogs are German Shepherd Dogs or Belgian Malinois. However, an alternative breed, the Drever, has been suggested as having potential. Drevers are small, Scandinavian scent hounds. The potential of this breed is being tested experimentally in a training programme in South Africa.

This study examined the behaviour of four Drevers during training for landmine detection, in comparison with seven Belgian Malinois. The dogs, all under a year old, were observed during training sessions, where they were being trained to search for the scent of explosives. The aim was to investigate any differences between the behaviour of the breeds that were relevant to mine detection, with a view to assessing the potential of the Drever as a breed of mine detection dog. The behavioural data were converted to percentages and rates and comparisons between breeds were performed using Mann-Whitney U tests. Aspects of the training techniques used for each breed were also recorded and analysed.

The results indicated that Drevers were more easily distracted than Malinois. Although the Drevers spent more time in inappropriate search behaviour than the Malinois, the time spent in appropriate search behaviour was similar in both breeds, as was the level of attentiveness. Neither breed showed greater dependence on the handler or less obedience. The only aspect of the training technique that differed between the breeds was in the timing of the reward.

Although only a field study, it was concluded that Drevers have the potential to be successful as mine detection dogs, but that training techniques may need to be adapted to suit a breed with a different temperament. A follow up study would be useful in which controlled tests are employed to assess their characteristics.

Keywords: dogs, Drevers, landmine detection, Malinois, training

1. Introduction

The number of services for which dogs are trained is forever increasing. Many of these roles utilise dogs' excellent olfactory capabilities, such as tracking criminals (Settle et al., 1994), searching for survivors after disasters (Komar, 1999), alerting people to impending seizures (Strong et al., 1999), and the detection of drugs (Adams and Johnson, 1994), explosives (Gazit and Terkel, 2003), and contraband food (Furton and Myers, 2001). One such field that has recently expanded is the use of dogs to detect landmines. The use of dogs as mine detectors was first utilised during World War II, but they have become more commonly used in the last few years (Goth et al., 2002). Currently over 600 dogs are being used in humanitarian demining programmes (Goth et al., 2002). Dogs can detect the vapour emanating from the explosive contained within the mine (Phelan and Webb, 2002). Mine detection dogs are trained to associate this scent with reward. Generally, they are taught to sit when they detect the scent and await instructions from their handler.

There are several benefits in using dogs as landmine detectors. They can work faster than machinery (Furton and Myers, 2001); they are low-tech; they are more versatile and more sensitive (Waggoner et al., 1998); and they can be produced locally in poorer areas (GICHD, 2001a). Modern mines are often made with plastic parts (Coren, 2000) and the low metal content often makes them undetectable by metal detectors. However, this is not a problem for dogs and neither is detecting mines in areas with a high concentration of metal debris (Goth et al., 2002). Although other animals, e.g. rats (GICHD, 2001a), may have detection capabilities, dogs, probably because of the relative ease of training them, have become the prime candidates for the job.

One factor that has a major influence on the aptitude of a dog for its job is its breed. Dogs are bred to excel at specific tasks (Lindsay, 2000; Christiansen et al., 2001). Much research has gone into breeding suitable dogs for specific services e.g. guide dogs (Pfaffenberger et al., 1976; Goddard and Beilharz, 1982). To date little research has focused on what the most suitable breed of dog to use in mine detection would be. There is also a scarcity of research on the efficiency of operational dogs. Most operational demining dogs are either German Shepherd Dogs or Belgian Malinois (GICHD, 2001b). Belgian Malinois are one of four types of Belgian Shepherds (Stockman, 1998) and are thought to be genetically similar to German Shepherd Dogs (Jennings, 1991). The army traditionally uses these breeds and so are familiar with the most effective way to train them (GICHD, 2001a). In addition, these breeds have

proven their capabilities (GICHD, 2001b) so are safer to use than unknown breeds in a decidedly hazardous working environment. Consequently, there may be some resistance to introducing new less well-known breeds.

Nevertheless, improvements to the industry could be made, if a superior breed was found. Before a suitable breed can be selected, the characteristics of a good mine detection dog must be identified.

Obviously, olfactory capabilities are an important factor in detection ability. There have been mixed reviews on whether dogs are capable of detecting landmines (Ashton and Eayrs, 1970; Nolan and Gravitte, 1977). The reliability of dogs' detection capabilities are often questioned because their ability cannot be accurately assessed (Williams and Johnston, 2002). However, olfactory capability is not a deciding factor when choosing a particular breed (Furton and Myers, 2001), because any dog should possess a good sense of smell, regardless of breed.

The characteristics that have been proposed as important when choosing a mine detection dog are that the dog searches with its nose close to the ground; that they have a high intensity of focus; will work repetitively while maintaining consistency; they are slow moving; enthusiastic; and are physically resilient (GICHD, 2001a). In addition, high trainability would be advantageous. Important qualities, with regards to the safety aspects, are that the breed is responsive to the handler and that it is as reliable as possible.

The shepherds that are commonly used are considered to be intelligent (Jennings, 1991) and highly trainable (Fisher, 1995), and are responsive to their handlers (GICHD, 2001b). However, it has been suggested that these qualities are not specifically related to mine detection (GICHD, 2001a) and there may be other breeds with more relevant characteristics. Several working breeds have been suggested as potential alternatives, including Labradors, Border Collies, Beagles, Springer Spaniels, and one less conventional choice, the Drever.

Drevers are small, rectangularly built scent hounds (Grandjean, 2000). They were bred from German Dachsbracke and Danish Strellufstövare (Morris, 2003), with the first breed standard being determined in 1953 (Grandjean, 2000). They are thought to exhibit many of the characteristics that are valuable in mine detection. Grandjean (2000) described Drevers as

" Tenacious, courageous and alert, with an . . . .exceptional nose and a loud voice . . . needs a firm owner" (Grandjean, 2000).

The Drevers' small size may also be an advantage for this occupation, since they are more easily transported and there is less chance that they will detonate mines (Morris, 2003).

Although Drevers may possess many of the key characteristics required for mine detection there is no scientific evidence to support this possibility. To determine their potential as operational mine detection dogs, it is useful to study their behaviour in a practical situation, in comparison with an established breed. This paper describes a field study, which compares the behaviour of two breeds, the Drever and the Belgian Malinois, being trained for mine detection. The study makes field observations on the behaviour of the two breeds during training and attempts to identify any obvious behavioural characteristics relevant to their capabilities as mine detection dogs. The findings were then used in an attempt to assess the potential of the Drever as a breed of mine detection dog.

2. Methods

These data were collected over a five-week period during the months of May and June at the Mine Dog Centre, near Pretoria, in South Africa. The centre houses approximately 40 dogs, most of which are being trained to be, or already are, operational mine detection dogs.

2.1 Animals

Seven Belgian Malinois and four Drevers were studied (Table 1). The Belgian Malinois is the preferred breed for mine detection work. The Malinois had been bred at the centre and were 8 months old at the beginning of the study. Six Drevers were donated to the centre by the Geneva International Centre for Humanitarian Demining (GICHD) as part of their programme investigating the Drever as a potential breed of demining dog. The Drevers travelled to South Africa from Sweden when they were two months old. The eldest two of the six did not progress sufficiently in early assessments so were rejected for further training and thus were not included in the study. The four Drevers kept in the training programme are two sets of male siblings; one set being two weeks older than the others. The older pair were 10 months old at the beginning of the study.

Table 1
Details of dogs involved in the study

Dog's name	Breed	Sex	Age at beginning of study
Candis	Malinois	Female	8 months
Candy	Malinois	Female	8 months
Casper	Malinois	Male	8 months
Charlie	Malinois	Male	8 months
Chompie	Malinois	Male	8 months
Cola	Malinois	Male	8 months
Conan	Malinois	Male	8 months
Eddy	Drever	Male	10 months
Elvis	Drever	Male	10months
Eric	Drever	Male	9 ½ months
Ernie	Drever	Male	9 ½ months

2.2 Housing

The kennel block was made up of two parallel lengths of twenty kennels each bordering two other kennels, except for those on the end (Fig. 1a and 1b). Each dog was housed individually (Fig. 2). The kennels were enclosed with mesh, which meant that dogs were able to gain visual and transitory tactile contact with dogs on either side. They were also able to look out of the front over a small wall. Each kennel contained a raised stone platform with a wooden crate placed on top and a drinking bucket (Fig. 3). The kennels were stone floored and each had a drain running horizontally across the middle. Dogs were fed once a day in the late afternoon.

Fig. 1a. View of front kennel block.

Fig. 1b. View of rear kennel block.

Fig. 2. Individual kennels. A Malinois is housed in the kennel on the left and a Drever is housed in the kennel on the right.

Fig. 3. Kennel in detail. The photograph shows the raised platform at the rear and the water bucket.

2.3 Early training and socialisation

Early training of these de-mining dogs had involved encouraging the dogs to play with and chase a Kong toy. The dogs had then been taught to associate the scent of the explosive with the Kong toy. The dogs in this study were now at the stage where the handlers were training them to search for a small piece of trinitrotoluene (TNT) within a set area, and then sit when they detected it.

Most afternoons, the dogs were taken out for socialisation sessions where handlers exposed the dogs to as many different situations as possible. These experiences aimed to help the dog to cope with any unusual situations they might face in the future. Exposure to various conditions is also considered to help with minimising the risk of the dog becoming distracted while working (Morris, 2003).

The Malinois' socialisation started immediately they were born because they were born at the centre (the Mine Dog Centre's socialisation programme can be viewed at www.minedogcentre.com). The Drevers, however, did not start socialisation until their arrival at the centre at 2 months of age. Socialisation is continued throughout their training. The dogs were again transported in trailers to the various locations used for socialising them, such as parks and shopping centres. The centre also had its own socialisation compound, which housed an obstacle course (Fig. 4a and 4b).

Fig. 4a. Right-hand side of socialisation compound. This side of the compound includes vertical logs, horizontal tunnels, a rope bridge, an A-frame and a hut in which music plays and disco lights flash.

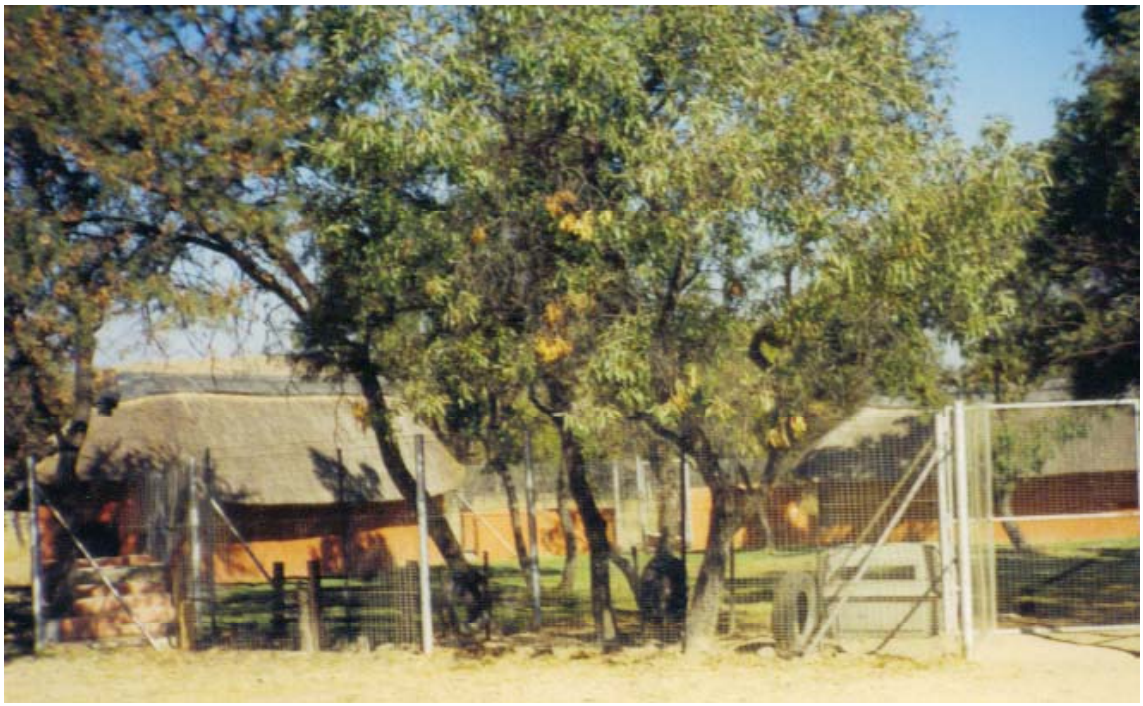

Fig. 4b. Left-hand side of the socialisation compound. This side of the compound includes vertical tyres, two sets of stone steps joined by a plank bridge and a hut with movement activated lights.

2.4 Training Protocol

A typical working day (Monday to Friday) at the centre began at around 6.45am and ended at 4pm. First thing in the morning, the dogs were loaded into trailers, in which they were transported to various locations, no more than 10 minutes drive from the

centre, for training. The four Drevers were transported in one trailer and the seven Malinois were transported in another. In this study, two different locations were used (referred to as Location 1 and 2), and they were within five minutes drive of each other. The location for training is changed during the training programme so that the dogs become accustomed to searching on different terrain, which is a vital skill if they are to become operational dogs. During the study, the Drevers had three recorded sessions at Location 1 and six at Location 2, whereas the Malinois had eight at Location 1, and two at Location 2.

Dogs arrived at the training locations at around 7am. The handlers then set up their training equipment. Each dog was taken out individually and given a short walk on a flexi lead before training began; the other dogs remained in the trailer. When ready to begin training, the dog was put on a short lead, which was then attached to a metal pin (approx. 20cm high), hereafter referred to as the anchor pin, placed 2m from the edge of the specified search area. The specified search area was demarcated by either a taped box or by guide lines (Fig. 5). The taped box consisted of 4 metal pins fixed vertically into the ground and set 2m apart in a square. The area was then enclosed with minefield marking tape (see Fig. 5). The guide lines were laid flat on the ground and were attached at either end by a 2m metal rod. The lines were 12m in length and each lane was 40cm wide, so one set consisted of five lanes. The dog remained tied to the anchor pin while the handler placed a small piece of TNT within the search area. This was always done using tweezers to prevent the TNT becoming contaminated with human scent. The explosive was placed randomly at the handler's discretion.

The dog was attached to a long lead while it was being asked to search. Alternative methods of working mine detection dogs are, on short leads or as free-search dogs (see GICHD, 2001a). The dogs were always kept on the lead while being trained. All dogs were encouraged to search by the handler opening his palm in front of the dog. When the dog found the explosive it was encouraged to sit and then it was given both tactile and verbal praise. The dog was then rewarded by the presentation of the Kong, which was thrown for the dog to fetch. The dog was then encouraged to return to the handler with the Kong, where it would receive more praise. The dog was then re-attached to the short lead and tied to the anchor pin. The handler would then retrieve the TNT and place it in another position within the designated search area. Once on the long lead, the dog would be asked to search again and the whole process repeated as many times as the handler deemed appropriate. Most sessions involved working until 4 or 5

rewards had been achieved. The Kong was always thrown back into the search area at the end of a session. The session was considered to be completed when the dog was returned onto the flexi lead.

Fig. 5. Guide lines set out for searching. One set of guide lines is shown. The dog is taught to search up and back one lane at a time. Minefield marking tape can be seen at the edge of the search area. Photograph courtesy of I. McLean, GICHD, 2001a.

One handler trained all the Drevers and another handler trained all the Malinois. The two breeds of dogs were worked in slightly differently set ups but they were being trained to do exactly the same task. The Drevers were initially trained in taped boxes, but the two younger ones had progressed to lanes (Fig. 5) by the end of the study period. The Malinois were trained to search in lanes throughout the study, although in most training sessions they only worked in the first two lanes. On two observed occasions the Malinois were trained in taped boxes rather than lanes. The dogs observed working in boxes were Candy (N=2), Cola (N=1) and Casper (N=1).

All dogs were provided with frequent finds because they were still in the early stages of training. Usually, dogs were only brought out for one session but occasionally they were given two training sessions. However, only first sessions were included in data analysis. The search area for the Drevers was altered more frequently because the handler was still trying to ascertain the best way to train them. Various approaches were adopted to try to improve their responses, including contaminating a small piece of

Kong with the scent of the explosive and placing it in the search area, and walking a trail in the grass, to exploit their natural trailing instinct. Dogs tended to return to the centre at about 10am, their kennels having been cleaned while they were out training.

2.5 Data collection

The study consisted of observing the dogs' behaviour during their training sessions and documenting their behaviour with the use of an ethogram (Table 2). An important distinction was made in the ethogram between walk sniff and walk nose up. The detection of the scent is improved if the dog's nose is at ground level (GICHD, 2001b) hence the distinction between these two behaviours.

All data were collected between 7.30am and 10am. The dogs of each breed were watched on separate days and the days were allocated randomly. In all but one session of observing the Drevers, all four dogs were trained. The Malinois trainer tended to train four dogs on each day because training all seven was not possible in the available time. In the first 13 observation sessions, the length of time the training sessions lasted, the behaviour during the training sessions, the number of finds during a session, and the obedience of each dog were recorded. The session was timed, using a stopwatch, from the moment the dog was put on the short lead until it was put back on the flexi lead. The behavioural data were collected using instantaneous sampling at 10-second intervals. The order in which the dogs were observed was determined by the handler. The obedience to verbal commands was investigated over a short period within the training period. This was selected randomly and lasted 2 minutes. A dog was marked as having obeyed a command if it responded correctly at first asking, irrespective of how good the response was. Otherwise, it was noted as having disobeyed. Each time the dog correctly signalled a find it was noted. The number of finds equalled the reward rate because at this stage, reinforcement was continuous.

Table 2
Ethogram of behaviours seen during training

Behavioural class	Behavioural act	Description
Locomotive	Approach	Dog moves directly towards handler while looking at handler
	Chase	Dog moves towards Kong at an accelerated pace
	Fast	Any movement quicker than walk while not chasing Kong
	Play	Sequence of playful movement which may involve handler
	Walk look else	Dog's gaze is focused anywhere else except handler or Kong while walking
	Walk look handler	Dog's gaze is focused on handler while walking in any direction
	Walk look Kong	Dog's gaze is focused on Kong while walking
	Walk nose up	Dog walks with nose near ground but does not sniff
Investigative	Lie sniff	Sniffs search area while body flat on ground
	Lie sniff else	Sniffs ground outwith search area while body flat on ground
	Lie sniff handler	Sniffs handler while body flat on ground
	Sit sniff	Sniffs search area while resting on haunches
	Sit sniff else	Sniffs ground outwith search area while resting on haunches
	Sit sniff handler	Sniffs handler while resting on haunches
	Stand sniff	Sniffs search area while remains still on all fours, nose in contact with ground
	Stand sniff else	Sniffs outwith search area while remains still on all fours
	Stand sniff handler	Sniffs handler while remaining still on all fours
	Walk sniff	Sniffs search are while moving forward, nose in contact with ground
	Walk sniff else	Sniffs ground outwith search area while moving forward
Actions	Drink	Intake water
	Hold	Holds Kong toy in mouth
	Praise	Accepts praise from handler, often shown by gazing upwards and tail wagging
	Pull look Kong	Dog exerts forward pressure on lead in an attempt to obtain Kong
	Pull	Dog exerts forward pressure on the lead, can have fore paws raised off ground
	Struggle	Moves to try to escape handlers hold
	Subordinate	Adopt a low posture, with ears back and eyes averted
Visual	Lie look else	Dog's gaze is focused anywhere other than handler or Kong while body is flat on ground
	Lie look handler	Dog's gaze focused on handler while body is flat on ground
	Lie look Kong	Dog's gaze is focused on Kong while body is flat on ground
	Sit look else	Dog's gaze is focused anywhere other than handler or Kong while resting on haunches
	Sit look handler	Dog's gaze focused on handler while resting on haunches
	Sit look Kong	Dog's gaze is focused on Kong while resting on haunches
	Stand look else	Dog's gaze is focused anywhere other than handler or Kong while remaining still on all fours
	Stand look handler	Dog's gaze focused on handler while remaining still on all fours
	Stand look Kong	Dog's gaze is focused on Kong while remaining still on all fours
Events	Bark	Loud rough vocalisation
	Jump on handler	Dog lifts front legs off ground and onto handler
	Paw	Directs single paw at object and may make contact with the object
	Play-bow	Front part of the dogs body positioned as if lying down, with back end in air
	Rollover	Dog rolls onto its back exposing its belly
	Scratch	Rubs body with claws
	Shake	Full rapid body movement from side to side
	Urinate	Hiking leg/squatting
	Yawn	Gaping of mouth

In the second stage of the project (the final 6 sessions), alternative aspects of the dogs' behaviour were recorded. The aim of this was to detect subtle differences in the behaviour of the breeds that were relevant to their suitability as mine detection dogs and to focus on particular aspects of the training style. Two specific event behaviours that were recorded were the rate of sudden stoppages during searching to stare elsewhere (usually in response to a noise) and the rate of turning away when being teased with the Kong (assumed to indicate disinterest in the reward).

Three criteria were used to look at the dependency of the dog on the handler; these were the number of times the dog looked up/back at the handler while it was supposed to be searching (look back), the number of times the direction of the dog was corrected with the lead while it was moving forwards and searching (corrections), and the number of reminders given to prompt the dog to continue searching (reminders). Reminders were given in the same form as the initial hand prompt (see section 2.4). The elements used to evaluate the training styles were the number of verbal commands given within a training session, the number of hand signals given, the frequency of verbal praise, the frequency of tactile praise, and the number of verbal and physical reprimands. For both verbal and tactile praise, each incidence of praise was counted. No record was made of the duration of verbal or tactile praise. From the beginning of the training session, the latency to find the TNT (first find) and the latency for the dog to receive its first reward were also noted. The Malinois Candis was not included in the second stage of the project because she was believed to be in season.

2.6 Statistical analysis

Complete training sessions were recorded. Training sessions ranged in length between 4½ minutes to 26 minutes. Ten minutes was estimated to be an average length of a training session and as such, 10 minutes was chosen to record the behavioural data with instantaneous sampling. This period was felt to be representative of the total training session and analysing the data in this way was thought to exclude any problems with dog 'fatigue' on the results. However, some sessions were shorter than 10 minutes so sessions that lasted between 7 and 10 minutes were used in analysis. All instantaneously sampled behaviours were converted to percentages of the total time of each session; this allows for differences in overall lengths of sessions. Any sessions shorter than 7 minutes were rejected from analysis because it was felt that short sessions

would give percentages that were unrepresentative of the true time spent performing particular behaviours.

Event behaviours (Table 2) were recorded over the whole length of the training session for the entire study period. All data that were recorded as frequencies were converted to rates, i.e. frequencies per hour. Many of the behaviours recorded as events did not occur frequently enough to allow statistical analyses to be carried out. The data collected on the dogs' obedience to commands were converted into percentages of obeyed versus disobeyed before being analysed. Although, the behaviours listed in Table 2 were sampled, related behaviours were merged into composite categories for analysis (Table 3).

To investigate differences in behaviour between breeds and differences in training style between breeds, the data were analysed using Mann-Whitney U tests (Dytham, 1999). The small sample size meant that non-parametric tests were used. Statistical tests were carried out using Minitab statistical software (Minitab 13 for Windows statistical software package).

Table 3
Composite behavioural categories used in statistical analysis for comparison of two dog breeds during training

Composite category	Sampled behaviours included in the composite category
Pulling	Pull; pull look Kong
Look Kong	Lie look Kong; pull look Kong; sit look Kong; stand look Kong; walk look Kong
Look else	Lie look else; sit look else; stand look else; walk look else
Look handler	Lie look handler; sit look handler; stand look handler; walk look handler
Sniff area	Lie sniff; sit sniff; stand sniff; walk sniff
Sniff else	Lie sniff else; sit sniff else; stand sniff else; walk sniff else
Sniff handler	Lie sniff handler, sit sniff handler, stand sniff handler
Investigative	Lie sniff; lie sniff else; lie sniff handler; sit sniff; sit sniff else; sit sniff handler; stand sniff; stand sniff else; stand sniff handler; walk sniff; walk sniff else
Handler orientated	Approach; lie look handler; sit look handler; stand look handler; walk look handler; lie sniff handler; sit sniff handler; stand sniff handler
Locomotive	Approach; chase; fast; walk look else; walk look handler; walk look Kong; walk nose up; walk sniff; walk sniff else
Inattentive	Lie look else; sit look else; sit sniff else; stand look else; stand sniff else; walk look else; walk sniff else

For definitions of sampled behaviours, see Table 2.

3. Results

3.1 Behavioural time budgets

The total time each dog was trained over the study period, the number of sessions each was watched for and the median length of the daily sessions during the study were calculated (Table 4). The lengths of training sessions did not differ across the breeds.

Median time budgets of selected behaviours for each breed are shown in Fig. 6a and Fig. 6b. The figures illustrate that the most common behaviour during training was holding the Kong. Other behaviours that formed relatively large proportions of the time budgets were 'sit look handler', 'stand sniff' and 'walk sniff'. This was expected because these are the main behaviours that should be seen during effective training (full definitions in Table 2).

Table 4
Summary of dogs' training over the study period

Dog's name	Dog breed	Total time trained over the entire study period (to nearest minute)	No. of sessions observed	Median length of training sessions + [inter-quartile range] (seconds)
Casper	Malinois	87	7	675 [600, 970]
Cola	Malinois	73	7	695 [520, 780]
Conan	Malinois	109	7	810 [720, 1140]
Charlie	Malinois	86	6	790 [683, 964]
Candis	Malinois	40	4	675 [368, 735]
Candy	Malinois	107	7	890 [690, 980]
Chompie	Malinois	48	4	710 [622, 812]
Elvis	Drever	129	9	850 [662, 1035]
Eddy	Drever	134	9	900 [725, 1032]
Ernie	Drever	87	8	575 [350, 974]
Eric	Drever	122	8	815 [723, 968]

3.2 Behavioural analysis

3.2.1 Composite behavioural categories

Median time budgets of selected behaviours for each individual dog are shown in Table 5a (Drevers) and Table 5b (Malinois) (full behavioural time budgets in Appendix 1). There was no difference in the time the breeds spent focused on the reward (= Kong) (Fig. 7). When all the pull behaviours were merged, it was found that Drevers pulled more than the Malinois (Mann-Whitney U, $W = 38.0$, $p = 0.01$, Fig. 7).

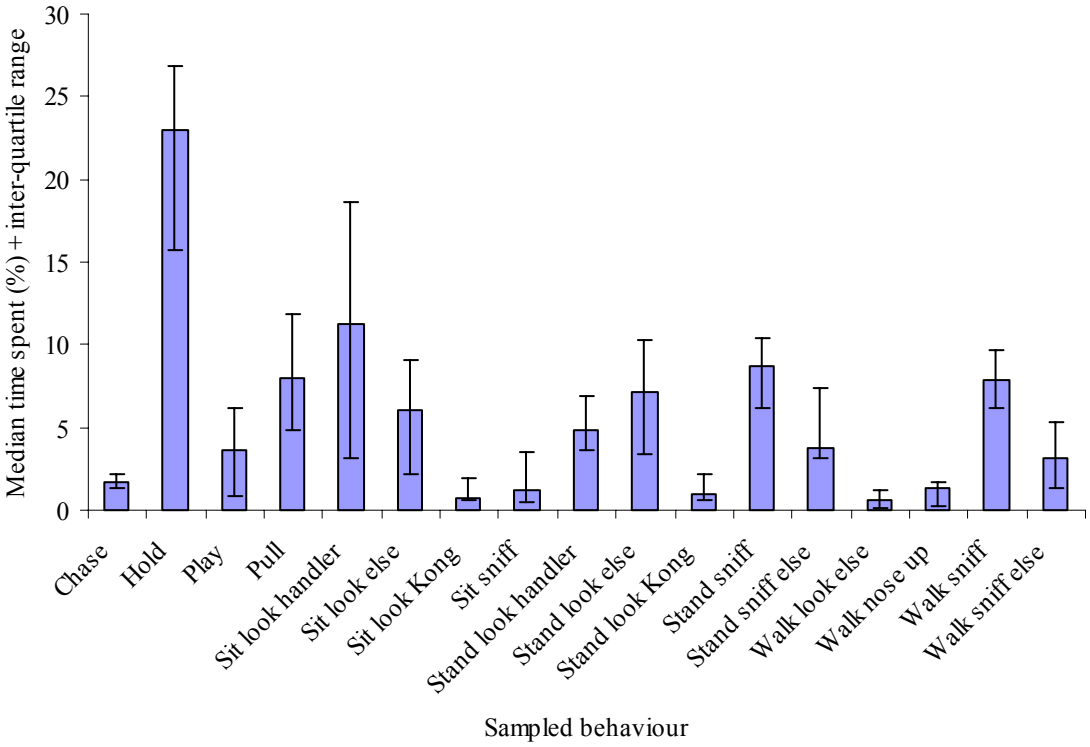

Fig. 6a. Drevers' behaviour during training. Behaviours forming less than 1% of the time budget were omitted from the figure.

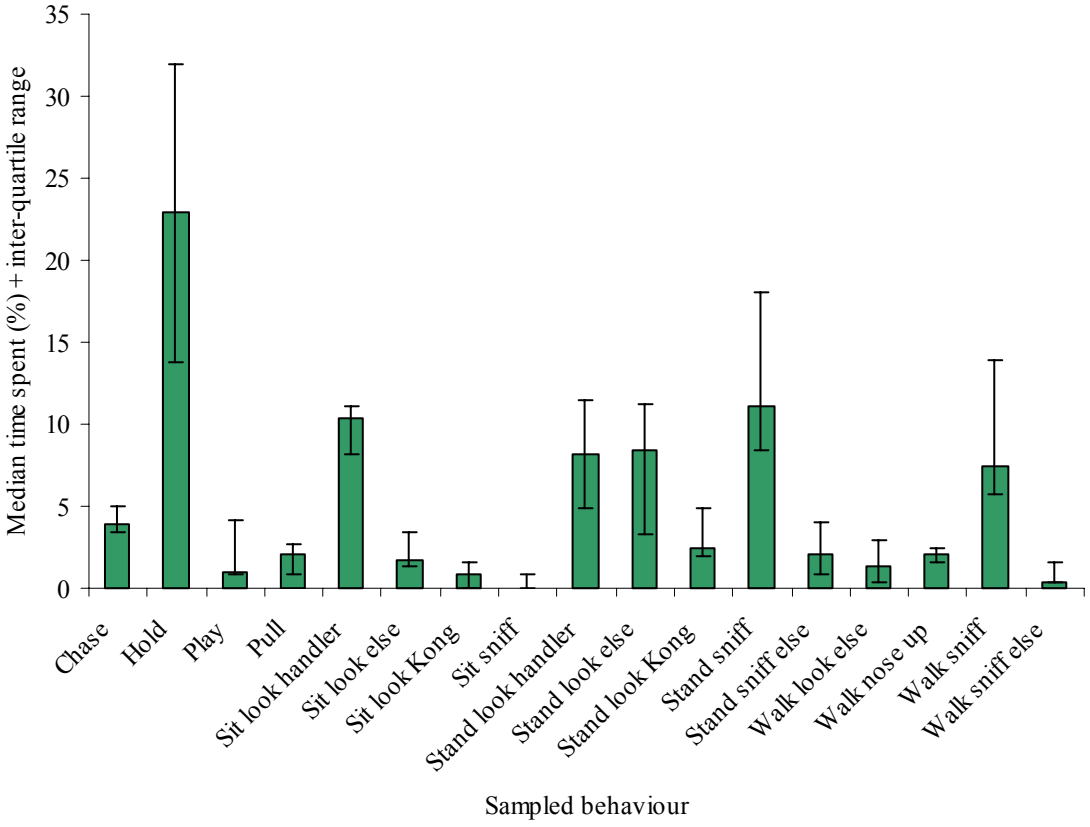

Fig. 6b. Malinois' behaviour during training. Behaviours forming less than 1% of the time budget were omitted from the figure.

Table 5a
Time budgets of composite behavioural categories for individual Drevers during training

Composite behavioural category	**Median time spent (%) + [inter-quartile range]**			
	Eddy (N=6)	Elvis (N=6)	Eric (N=6)	Ernie (N=4)
Pulling	10.66 [8.61, 11.89]	11.99 [7.38, 15.57]	6.56 [1.64, 8.61]	6.54 [5.32, 7.79]
Look Kong	1.64 [0, 2.87]	0.82 [0, 5.58]	1.64 [1.64, 5.33]	2.46 [0, 6.15]
Look else	13.93[11.48, 21.31]	5.74 [4.51, 9.12]	19.67[13.93, 25.00]	5.74 [4.49, 7.79]
Look handler	9.84 [9.84, 16.39]	14.75[12.70, 17.50]	19.67[14.75, 26.23]	23.98 [18.96, 32.38]
Sniff area	19.67[13.52, 23.77]	20.49[16.65, 24.18]	13.11[10.25, 18.03]	18.25 [13.52, 23.88]
Sniff else	12.30[11.07, 17.62]	3.72 [1.23, 6.97]	2.46 [1.64, 17.21]	5.72 [2.46, 9.01]
Sniff handler	1.64 [1.23, 2.46]	0 [0, 1.64]	0 [0, 0.41]	1.91 [0.41, 5.46]
Investigative	36.07[28.69, 39.75]	27.05[17.69, 29.92]	19.67[17.21, 25.00]	27.51 [18.44, 34.66]
Handler orientated	11.48[11.48, 18.85]	14.75[13.11, 18.73]	20.49[14.75, 26.64]	6.56 [4.49, 11.89]
Locomotive	21.31[12.70, 23.36]	13.93[12.24, 18.44]	15.57[12.70, 18.03]	12.30[11.02, 14.34]
Inattentive	25.41 [9.84, 41.39]	13.63 [6.97, 18.03]	23.77[15.98, 37.30]	7.63 [5.33, 13.24]

N = number of sessions each dog was observed for

There was no difference between the breeds for the percentage time spent sniffing within the search area (Mann-Whitney U, W = 17.0, p = 0.22, Fig. 7), or in the attentiveness of the two breeds (Mann-Whitney U, W = 41, p = 0.92, Fig. 7). Candis had the highest percentage of inattentive behaviour of all 7 Malinois (Table 5b).

There was no difference in overall investigative behaviour (Fig. 7). However, the time spent 'sniffing else' was larger in the Drevers (Mann-Whitney U, W = 35, $p < 0.05$, Fig. 7) and the Drevers spent more time sniffing their handler than the Malinois (Mann-Whitney U, W = 38, p = 0.01, Fig. 7). 'Sniffing else' will be referred to as inappropriate search behaviour hereafter. The Malinois showed more locomotive behaviour during training than the Drevers (Mann-Whitney U, W = 11, p = 0.02, Fig. 7).

Table 5b

Time budgets of composite behavioural categories for individual Malinois during training

Composite behavioural category	**Median time spent (%) + [inter-quartile range]**						
	Candis (N=2) $^{\delta}$	Candy (N = 5)	Casper (N = 6)	Charlie (N = 4)	Chompie (N = 2) $^{\delta}$	Cola (N = 5)	Conan (N = 4)
Pulling	2.46	3.28 [0, 8.20]	0 [0, 3.69]	1.64 [0, 4.51]	0.82	1.89 [0.82, 4.92]	1.64 [0.41, 4.10]
Look Kong	8.20	6.56 [3.28, 13.11]	3.62 [0, 6.97]	2.46 [0, 7.38]	9.84	1.89 [1.76, 8.20]	4.10 [3.28, 6.15]
Look else	25.41	14.75 [9.84, 18.03]	18.66[13.52, 21.72]	4.10 [3.28, 7.38]	8.20	11.48[10.58, 12.30]	9.84 [5.74, 13.93]
Look handler	19.67	14.75[11.48, 21.31]	21.12[13.52, 29.51]	13.11[11.89, 26.64]	18.03	26.23[23.77, 28.91]	21.31 [9.43, 25.82]
Sniff area	11.48	21.31[16.39, 33.61]	24.59[19.41, 27.87]	24.59[19.67, 36.89]	23.77	11.48[10.58, 22.95]	24.59[19.67, 29.51]
Sniff else	6.56	0 [0, 0.82]	4.92 [1.23, 8.47]	1.64 [1.64, 1.64]	0.82	4.92 [1.64, 10.21]	3.28 [0.82, 3.28]
Sniff handler	0.82	0 [0, 0.82]	*	0.82 [0, 1.64]	0.82	0 [0, 2.46]	0 [0, 1.23]
Investigative	18.85	22.95[16.39, 34.43]	27.07[25.82, 34.02]	27.05[21.31, 40.16]	25.41	22.95[17.51, 27.05]	28.69[22.95, 30.74]
Handler orientated	21.31	14.75[12.30, 21.31]	22.28[14.75, 30.74]	13.93[13.11, 27.05]	18.85	28.30[25.41, 30.33]	22.13[10.66, 26.23]
Locomotive	19.67	16.39[13.93, 25.41]	17.21[13.33, 29.10]	22.13[18.44, 25.82]	20.49	20.75[17.21, 23.77]	14.75[10.25, 22.95]
Inattentive	31.97	14.75 [13.12, 16.39]	26.23[19.67, 31.28]	5.74 [4.92, 9.02]	9.02	14.75[12.34, 21.31]	11.48 [8.20, 17.21]

N = number of sessions each dog was observed for. $^{\delta}$ denotes no inter-quartile range for this dog. * denotes that the dog did not perform any behaviours in this category

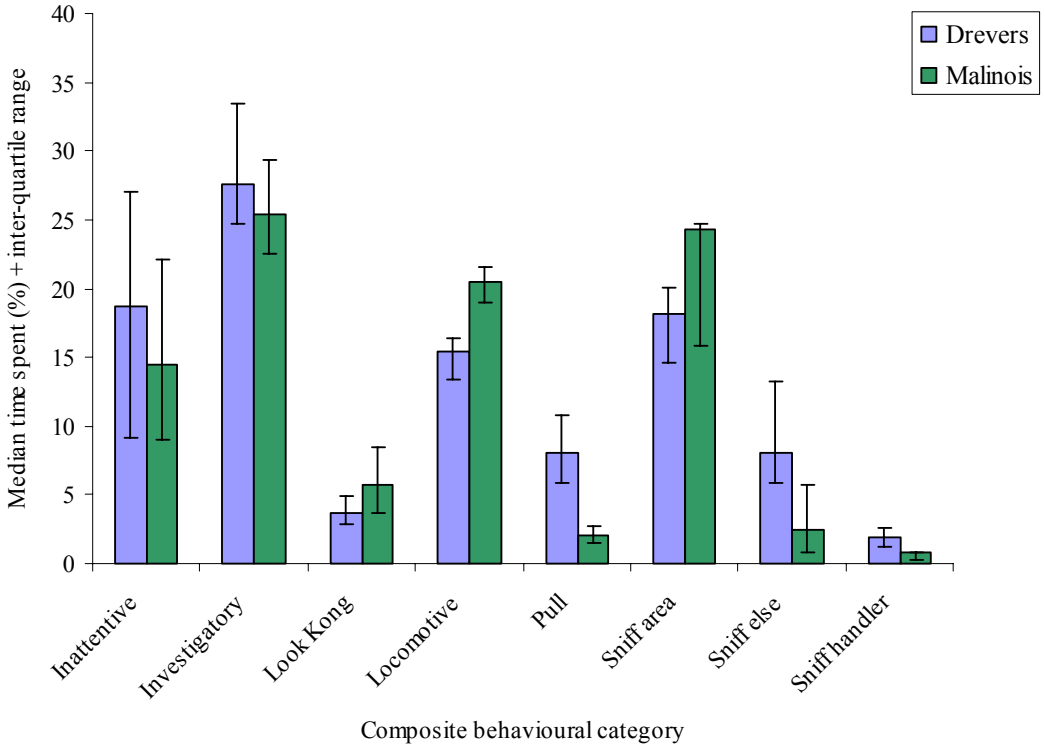

Fig. 7. Comparison of composite behavioural categories between two breeds of dog during training. There were significant differences between the breeds for four of the composite behavioural categories, namely 'locomotive', 'pull', 'sniff else' and 'sniff handler'.

3.2.2 Characteristic behaviours

The Drevers were found to bark more than Malinois during training (Mann–Whitney U, W = 35, p = 0.03, Fig 8). Drevers also rolled over more than Malinois (Mann–Whitney U, W = 36.0, p = 0.02, Fig 8). The rate at which the Drevers suddenly stopped searching and looked elsewhere was much higher than that of the Malinois (Mann–Whitney U, W = 33.0, p = 0.02, Fig 8). The dependency on the handler did not differ between the breeds. The median rates of looking back at the handler were relatively low (Fig. 9) whereas the numbers of reminders needed were higher (Fig. 9).

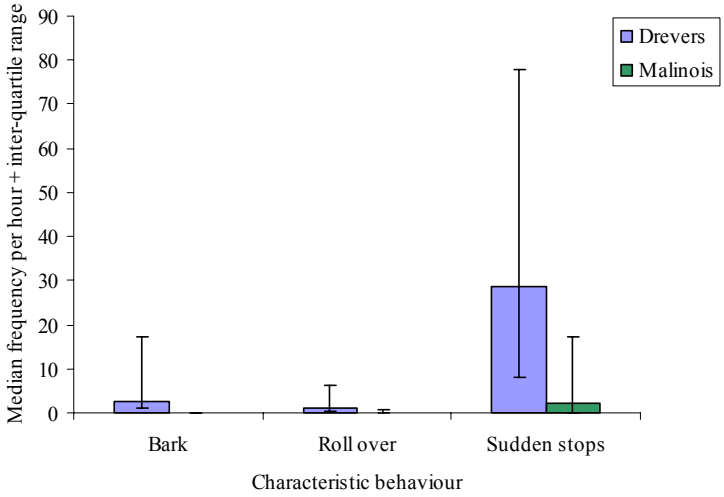

Fig. 8. Median rates [+ inter-quartile range] of characteristic behaviours observed during training in two breeds of dog. Drevers were seen to bark, roll over and suddenly stop searching significantly more often that Malinois ($P<0.05$).

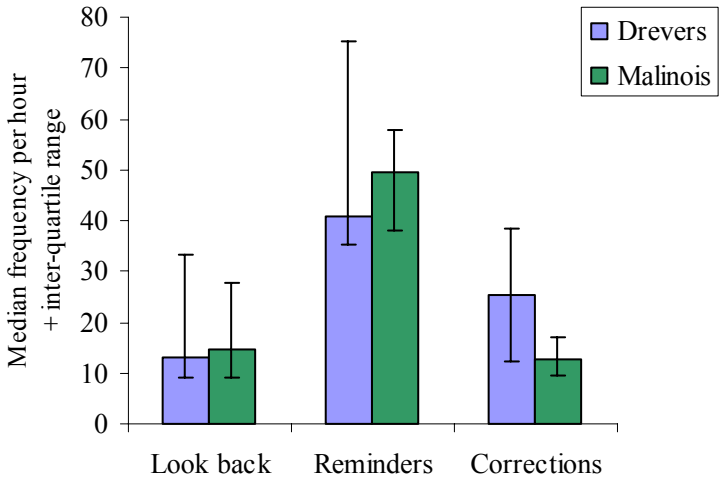

Fig. 9. Median rates [+ inter-quartile range] of looking back at handler, reminders and corrections during training in two breeds of dog. These measures were used to assess the breed's dependency on the handler. None of the measures differed significantly between the breeds.

3.3 Training techniques

No significant difference was found between the obedience of the breeds. The number of finds is equivalent to the number of rewards (reward = presentation of the Kong) because the dogs were always rewarded for a find. The dogs made a find approximately every 3 minutes (Table 6) and thus, they were rewarded with the Kong on approximately the same schedule. The median rate of finds and time between finds did not differ between breeds.

Table 6
Summary of the rate of finds during training

Dog's name	Median time between finds and inter-quartiles ranges (s)
Candis	180 [164, 270]
Candy	160 [132.7, 172.5]
Casper	148 [133, 161.25]
Charlie	166 [138, 195]
Chompie	172.5 [158.2, 174.2]
Cola	173.3 [150, 195]
Conan	156 [118.3, 162]
Eddy	212.25 [184.8, 231.9]
Elvis	157.5 [132.75, 175]
Eric	224.3 [188.2, 234.6]
Ernie	156.7 [150, 182.5]

Latency until the first reward in a training session was longer for Drevers than for Malinois (Mann-Whitney U, W = 152.0, p = 0.02, Fig. 10), but there was no significant difference between the latency until the first find (detection of TNT) (Fig. 10). The frequency of commands, praise and punishment did not differ between the handlers.

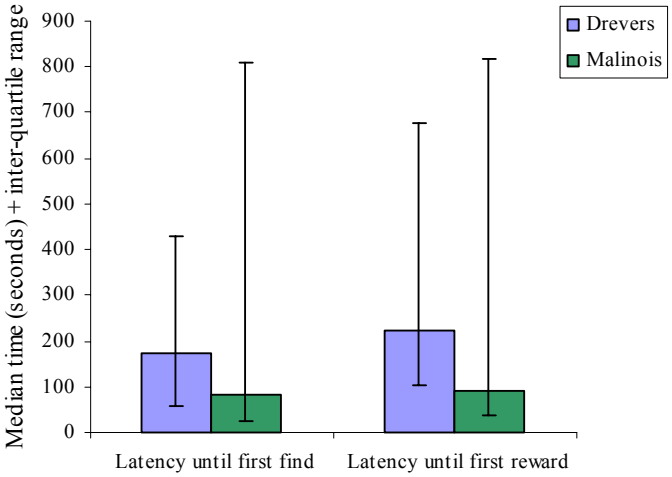

Fig. 10. Latencies until first find and first reward during training in two breeds of dog. The latency until first find was not significantly different between breeds but the latency until first reward was ($p<0.05$).

4. Discussion

The aim of this study was to seek to identify any differences in behaviour between two breeds of dog during training for landmine detection, and thereafter, use the results to assess the potential of the Drever as a breed of mine detection dog.

4.1 Behavioural analysis

The behavioural analysis shows that appropriate search behaviour and the level of attentiveness was similar in the two breeds, but that inappropriate search behaviour was more common in the Drevers, as were sudden disruptions in their searching behaviour. Drevers appeared more enthusiastic towards the task, though the focus on the reward was similar in both breeds. Neither breed appeared to be more dependent on the handler than the other.

4.1.1 Composite behavioural categories

Higher levels of inappropriate search behaviour were likely in a breed such as the Drever. The Drevers' nature predisposes them to investigate the multitude of signals within their environment. Drevers could find investigation of their environment reinforcing in itself, as this has been reported in other dogs bred for hunting (Fox, 1965). A particular concern with regards to this breed's role in mine detection, was the possible difficulty of focusing the Drevers' exploratory instinct on the required task (GICHD, 2001a). These results reinforce this concern. Drevers may require additional stimulation at other times to satisfy their exploratory instinct. Providing them with simple forms of enrichment in their kennels (Hubrecht, 1993; Hubrecht, 1995) is one possible way of addressing this problem.

Although, the amount of inappropriate search behaviour suggests that Drevers may be less focused on the task, no significant difference in overall attentiveness was found between the breeds. The similarity in overall attentiveness is puzzling. It could be due to weaknesses in the statistical analysis. Non-parametric statistics are less powerful (Dytham, 1999), and ranking the data results in loss of accuracy.

Appropriate search behaviour was also similar in the two breeds. Malinois are considered a standard breed with which to compare alternative breeds due to their proven success in the field (GICHD, 2001b). Thus, the similarity in appropriate search behaviour is an encouraging result with regards to the development of Drevers as mine detection dogs. However, as before, the similarity in the results for the two breeds may be due to the small sample size and the weaker statistical tests.

Training of the Drevers appeared to be more difficult for the handler. Several different approaches were taken to encourage them to search in the correct area (see section 2.4). This was surprising as it was expected that Drevers, being natural hunters, would be more easily trained to search (Hart and Miller, 1985). However, Shepherd

(2002) noted that in some breeds, when training for particular tasks, the trainer might find it more difficult to overcome natural behaviour, in this case, the focus being on the Drevers' searching behaviour in the correct area. The difficulties may have been caused by the trainer's lack of experience with these dogs, and need not necessarily indicate a lower level of trainability. An accurate comparison is not possible since there were no formal records of when training of each breed had begun and it was not possible to determine whether the Malinois had behaved in a similar way at the same stage of training.

Examination of individual training sessions revealed that the searching behaviour of individual dogs from both breeds was inconsistent from session to session. This is normal when training animals (Fisher, 1992). However, within this particular context, there are several additional explanations for this inconsistency. Firstly, the dogs were being trained in an environment with a multitude of distractions e.g. other dogs, vehicles, people and other animals. Secondly, there were changes in location across training sessions. Further, account should be taken of the possibility that the dogs' behaviour was affected by 'latent learning'. Often when a training exercise is stopped for a few days, a marked improvement is seen in performance on returning to the exercise (Fisher, 1992). The reasons for this are not entirely clear. However, it has been suggested that stopping the training not only prevents any deterioration in performance but by reducing the pressure on the animal to perform correctly, the animal's previous learning experience may become evident (Pryor, 1999). Introducing gaps into the training programme might have helped these dogs to progress more fluently.

The available reward could have had a large influence on the dogs' behaviour during training. Although no difference in the overall time focused on the reward (= Kong) was found between the breeds, the breeds differed in the type of reaction they had to the presence of the reward. Drevers were inclined to have a magnified reaction to the Kong, e.g. barking at it and pulling towards it. It is difficult to interpret whether this magnified reaction is advantageous or not. On one hand, it may suggest that Drevers are very eager to work for this reward and that using this reward is beneficial to their training. On the other hand, suggestions have been made within the industry (GICHD, 2001a) that using this type of reward to encourage hunting dogs to work may generate too much excitement and, consequently, have a disruptive effect on their ability to work

(O'Farrell, 1992). Finding a suitable replacement for this reward could prove problematic because of the highly-controlled nature of the work.

In addition to their magnified reaction to the reward, the Drevers also exhibited other behaviour that indicted they were enthusiastic with regards to the training (e.g. high levels of pulling forward). The apparent eagerness of these dogs appears to be characteristic of their breed description as 'overzealous' (Fogle, 2000). Being enthusiastic about the work is believed to be an important characteristic of mine detection dogs (GICHD, 2001b). Therefore, these behaviours would be considered a positive feature with regards to the proposed mine detection role.

4.1.2 Characteristic behaviours

Drevers tended to bark more during training. This higher incidence of barking might be considered a sign of excitement, but could also indicate their willingness to work. However, an increased tendency to bark may be simply because working dogs that are bred to bark while trailing, such as Drevers, are likely to bark in a situation similar to those of their natural working environment (Juarbe-Diaz, 1997).

Drevers also showed a higher incidence of rolling onto their backs during training. Although rolling over is often regarded as a signal of submission, in this context it appeared to be playful. Dogs often roll on their back as a sign of contentment when something pleasant has happened (Coren, 2000), and the behaviour was most often seen once the dog had received its reward.

The rate at which the Drevers suddenly stopped searching and stared elsewhere was much higher than that of the Malinois. This was thought to indicate lower levels of concentration. Being natural predators, dogs will be distracted readily by noises e.g. of birds or other animals. However, because Drevers have been bred for hunting, it is likely that they would be distracted more easily by such stimuli than Shepherds might be. This problem might have been exacerbated by the training environment (see 4.1.1.). It is possible that the Drevers would have benefited from undergoing training in a more controlled environment with fewer distractions until they were more competent with the required task. Furthermore, the higher levels of distracted behaviour seen in the Drevers could have been influenced by gender. Goddard and Beilharz (1982) noted that males were more easily distracted than females and all Drevers involved in the study were male.

Another key variable that may have largely influenced the responses to distractions during training was the degree of socialisation to which the two breeds had been exposed (Fox, 1965; Sauter and Glover, 1978). The heightened exposure to varying stimuli at a younger age most probably influenced the Malinois' responses to unexpected noises for example. It has also been shown that delayed socialisation can adversely affect working dogs' responses to training (Pfaffenberger and Scott, 1959).

Though consistent within themselves, these results were based on data from a small number of sessions and there were changes in training location within these sessions. Varying the location could have had profound effects on the response to training throughout the study. Pryor (1999) states that animals can fail to respond to known tasks when moved to a new location until they become accustomed to the new surroundings. Nevertheless, training these dogs in various environments is necessary because of the type of work they are being trained for. It also has the advantage that pattern training is avoided i.e. when the dog will only perform the behaviour in a certain context (Ross and McKinney, 1992).

4.1.3 Dependency on handler

The dependency on the handler was similar between the breeds. Minimising the dependency on the handler is considered an important aspect of training mine detection dogs (Fjellanger et al., in press). The dogs did not appear to seek reassurance very often, suggesting both breeds had a limited dependency on the handler even at this early stage. They did, however, need several reminders to continue searching. This could be indicative of low levels of concentration. This would be expected because these dogs are relatively young to be undergoing such complex training (Fox, 1965).

The rate of correction did not differ between the breeds but the Malinois appeared to react more adversely to correction and in a few cases refused to search after being corrected. There are known breed differences in the reaction to punishment (Scott and Fuller, 1965) and this should be taken into account in any training programme. In general, the Malinois appeared to be more affected by the handler's actions than the Drevers. Shepherds form strong bonds with people (GICHD, 2001a) and so, they may be more concerned with appeasing their handlers; this may not be of as great importance to the Drevers.

4.2 Aspects of the training technique

The only difference found in the training technique between the handlers was an increased delay until receipt of the first reward in the Drevers. As there was no difference in the time taken to find the TNT, this result indicates that the delay was a result of the training technique and not that the Drevers took longer to find the explosive. The delay of the reward could have significant implications regarding the dogs' response to the training programme. Delaying reinforcement affects the association between the desired behaviour and the reward. By delaying the reinforcement, the reward may not be associated with the correct behaviour (O'Farrell, 1992).

In landmine detection, it is not possible to immediately deliver the reinforcer to the dog when in the field. To aid the association between the TNT and the reward, clicker training could be used. However, discussion with one of the handlers revealed that there had been an attempt to clicker train the Drevers and it had not been successful. There are various reasons why an attempt to clicker train might not have been effective. Clicker training relies on precise timing so that a reliable association between the stimulus and the clicker is established. In addition, several pairings of the 'click' with the stimulus are needed before a strong association is formed (Ferguson and Rosales-Ruiz, 2001; Kaplan et al., 2002). The use of clicker training in horses found that even small variations in the conditions of training had disruptive effects on the animals' behaviour (Ferguson and Rosales-Ruiz, 2001). Therefore, the behaviour has to be shaped gradually, and in this case, progression may have occurred too quickly. However, since the details of the procedures used are not known, it is not possible to evaluate where any problems lay.

Another potentially troublesome aspect of the training technique was that dogs were rewarded on a continual schedule. Reinforcing on a continual schedule means that the dog has a very high expectation of reward (Lindsay, 2000). It also increases the chance of adverse effects on the association if a reinforcer is omitted (Pryor, 1999). These difficulties would be avoided if intermittent schedules were introduced as soon as the association between the stimulus and the reward was established (Lindsay, 2000).

Using different handlers for each breed probably affected the outcome of the study. It is known that a trainer's approach can affect how long their dog remains attentive (Garner et al., 2001). Trainers will also vary in their expectations of the dog (McKinley and Young, 2003).

Several other factors could have affected the dogs' responses during training including age (Ogburn et al., 1998), individuality (Fuller, 1955), temperature (Gazit & Terkel, 2003), wind direction and speed, and extraneous odours (Waggoner et al., 1998). In addition, Schoon (1997) stated that olfactory ability is subject to variation from one day to the next.

4.3 Conclusion

The behavioural analysis revealed few obvious differences in behavioural characteristics between the two breeds. Drevers appeared to be more enthusiastic, eager and playful whereas the Malinois had higher levels of concentration and appeared to be more sensitive to punishment.

The similarity in appropriate search behaviour and in the level of attentiveness between the breeds is encouraging with respect to development of the Drevers as many Malinois are already successful in the field. The behavioural analysis also suggests that the Drevers are willing to work in a situation that approximates to the working environment. The main challenge with respect to developing the Drevers as mine detection dogs would be to hone their exploratory instinct to the appropriate search area. In this field study, the Drevers were being trained as long lead dogs. However, their high incidence of inappropriate search behaviour could be reduced by using a short lead as it provides the handler with more control over the movement of the dog (GICHD, 2001a).

The problems with the Drevers' sudden losses of concentration could be reduced by modifying the training procedure or increasing stimulation at other times. Drevers may benefit from undergoing training in a less distractive environment until they are more competent in the required task. The environment in which the dogs were trained probably had a major influence on the behaviour of both breeds, as both were seen to lack consistency over individual training sessions.

The similarity in the level of obedience and the level of dependence on the handler between the breeds suggests that there would not be any overriding problems with Drevers' behaviour in these respects in an operational environment. These results are however confounded with the particular handler so cannot be considered definitive.

Many of the results reported here come from observing a very small number of sessions. A longer observation period would be necessary to note and record any obvious improvements. Gazit and Terkel (2003) noted improvement in detection

performance in the last six sessions when compared to the first six but in this study, some dogs could only be observed for two or three sessions. The reliability of the statistical analysis is also affected by the small sample size.

These are preliminary results. Since no experimental tests were set up, it is not possible to determine the effects of the many external variables that could have influenced the dogs' behaviour. The use of a single trainer for each breed also confounded the results. The indications are that Drevers have the capability to become an operational breed of mine detection dog but further investigation, including controlled experimental tests, would be necessary to found a firm conclusion.

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Appendix I

Full behavioural time budgets of sampled behaviours for individual Drevers during training.

	Median time spent (%) + [inter-quartile range]			
Behaviour	Eddy (N=5)	Elvis (N=5)	Eric (N=5)	Ernie (N=3)
Approach	0 [0, 0.82]	*	0 [0, 0.82]	*
Chase	1.64 [0.82, 2.46]	1.64 [0.82, 2.68]	1.64 [0, 2.46]	0 [0, 6.56]
Fast	1.64 [0, 1.64]	0 [0, 0.82]	*	*
Hold	13.11[7.38, 19.67]	19.67[15.71, 30.33]	26.23[12.30, 32.79]	34.43[14.75, 36.96]
Jump up	0 [0, 0.82]	*	*	0 [0, 1.64]
Lie look	0 [0, 0.82]	0 [0, 1.64]	1.64 [0, 2.46]	0 [0, 1.64]
Lie look else	*	0 [0, 1.04]	0 [0, 0.82]	0 [0, 1.64]
Lie look Kong	*	*	0 [0, 0.82]	0 [0, 3.28]
Lie sniff	0 [0,0.82]	*	*	*
Lie sniff else	*	*	0 [0, 0.82]	1.64 [0, 2.17]
Lie sniff handler	*	0 [0, 0.82]	*	*
Play	6.56 [2.46, 6.56]	6.25 [4.10, 9.02]	0 [0, 0.82]	1.64 [0, 4.92]
Pull	11.48 [6.56, 11.48]	11.48 [9.08, 16.39]	4.92 [1.64, 6.56]	6.52 [4.92, 8.20]
Pull look Kong	0 [0, 1.64]	0 [0, 2.08]	0 [0, 1.64]	*
Sit look	8.20 [4.10, 9.84]	8.20 [3.28, 9.02]	14.75[12.30, 18.85]	19.57[14.75, 24.59]
Sit look else	6.56 [2.46, 7.38]	1.64 [0, 3.28]	8.20 [4.92, 15.57]	1.64 [0, 1.64]
Sit look Kong	0 [0, 1.64]	0 [0, 1.64]	1.64 [0.82, 4.10]	0 [0, 1.64]
Sit sniff	0 [0, 0.82]	0 [0, 2.46]	0 [0, 3.28]	4.35 [1.64, 6.56]
Sit sniff else	0 [0, 0.82]	*	*	*
Sit sniff handler	0 [0, 1.64]	0 [0, 0.82]	0 [0, 0.82]	*
Stand look	4.92 [2.46, 7.38]	4.92 [3.28, 14.29]	1.64 [0, 7.38]	3.28 [2.17, 8.20]
Stand look else	9.84 [4.92, 16.39]	3.28 [2.46, 7.22]	9.84 [9.02, 10.66]	3.28 [1.64, 4.35]
Stand look Kong	1.64 [0, 2.46]	0 [0, 7.07]	0 [0, 1.64]	0 [0, 1.64]
Stand sniff	11.48 [8.20, 12.30]	8.33 [6.56, 14.75]	4.92 [4.10, 8.20]	6.52 [4.92, 9.84]
Stand sniff else	6.56 [4.92, 13.11]	2.08 [0.82, 5.74]	0 [0, 9.84]	4.35 [0, 6.56]
Stand sniff handler	1.64 [0.82, 1.64]	*	*	1.64 [0, 2.17]
Walk look	0 [0, 1.64]	0 [0, 1.04]	*	*
Walk look else	1.64 [0.82, 1.64]	0 [0, 1.64]	1.64 [0.82, 3.28]	0 [0, 1.64]
Walk nose up	0 [0, 2.46]	1.64 [0.82, 2.68]	1.64 [0, 3.28]	*
Walk sniff	6.56 [2.46, 11.48]	8.20 [5.36, 14.75]	3.28 [3.28, 9.84]	8.20 [8.20, 10.87]
Walk sniff else	4.92 [3.28, 8.20]	1.64 [1.64, 1.86]	1.64 [1.64, 9.02]	0 [0, 3.28]

N = number of sessions each dog was observed for. * denote that the behaviours was never performed by the dog.

Full behavioural time budgets of sampled behaviours for individual Malinois' during training

	Median time spent (%) + [inter-quartile range]						
Behaviour	Candis (N=2)[δ]	Candy (N = 5)	Casper (N = 6)	Charlie (N = 4)	Chompie (N = 2)[δ]	Cola (N = 5)	Conan (N = 4)
Approach	0.82	*	0.82 [0, 1.81]	*	*	0 [0, 1.64]	0 [0, 1.23]
Chase	4.92	3.28 [3.28, 4.92]	3.28 [3.04, 3.69]	2.46 [0.41, 3.28]	5.74	5.66 [2.46, 7.38]	1.64 [1.64, 7.79]
Fast	1.64	*	0 [0, 3.28]	0.82 [0, 2.87]	*	0 [0, 1.64]	*
Hold	11.48	26.23[18.03, 29.51]	13.93[9.43, 18.11]	34.43[26.64, 38.52]	31.97	18.03[13.11, 26.57]	22.95[20.08, 25.82]
Jump on	1.64	1.64 [0, 1.64]	0 [0, 0.41]	0 [0, 1.23]	*	0 [0, 0.82]	1.64 [0.41, 4.10]
Lie look	*	*	0 [0, 2.05]	0 [0, 2.46]	3.28	0 [0, 0.82]	*
Lie look else	*	0 [0, 0.82]	*	0 [0, 1.23]	0.82	*	*
Lie look Kong	0.82	0 [0, 1.64]	0 [0, 0.41]	0 [0, 4.92]	2.46	*	0 [0, 1.23]
Play	0.82	0 [0, 2.46]	0 [0, 2.05]	3.28 [2.05, 6.97]	*	1.89 [0.82, 4.10]	4.92 [1.23, 9.84]
Pull	2.46	3.28 [0, 6.56]	0 [0, 3.69]	1.64 [0, 4.51]	0.82	1.89 [0.82, 4.92]	0.82 [0, 1.64]
Pull look Kong	*	0 [0, 6.56]	*	*	*	*	0 [0, 3.69]
Praise	0.82	0 [0, 0.82]	0.82 [0, 1.64]	*	*	0 [0, 0.82]	0 [0, 1.23]
Roll over	*	0 [0, 0.82]	*	*	*	*	*
Sit look handler	8.20	6.56 [4.10, 9.84]	10.66[9.02, 12.00]	8.20[5.74, 19.26]	10.66	11.48[10.66, 12.34]	8.20 [4.92, 17.62]
Sit look else	6.56	1.64 [0, 2.46]	2.80 [1.23, 5.74]	0.82 [0, 4.10]	3.28	1.64 [0, 3.53]	0.82 [0, 2.87]

[δ] = no inter-quartile range for this dog. N = the number of sessions each dog was observed

Full behavioural time budgets of sampled behaviours for individual Malinois' during training

	Median time spent (%) + [inter-quartile range]						
Behaviour	Candis (N=2) [δ]	Candy (N=5)	Casper (N=6)	Charlie (N=4)	Chompie (N=2) [δ]	Cola (N=5)	Conan (N=4)
Sit look Kong	0.82	*	0 [0, 3.69]	*	4.92	0 [0, 0.82]	0.82 [0, 4.10]
Stand look	11.48	6.56 [4.92, 12.30]	7.93 [4.92, 15.57]	4.10 [3.28, 7.38]	4.10	13.21[9.84, 15.57]	4.92 [2.05, 12.70]
Stand look else	15.57	8.20 [7.38, 13.11]	12.71 [7.38, 16.39]	2.46 [1.64, 3.28]	3.28	8.20 [7.05, 9.84]	7.38 [5.33, 11.89]
Stand look Kong	4.92	6.56 [3.28, 9.84]	1.98 [0, 3.69]	0.82 []0, 4.10	2.46	3.28 [1.76, 8.20]	2.46 [0.41, 4.51]
Stand sniff	7.38	14.75 [9.84, 20.49]	18.03[14.67, 21.31]	9.02 [8.20, 15.98]	9.84	4.92 [2.58, 15.57]	15.57[13.52, 25.00]
Stand sniff else	4.92	*	3.28 [1.23, 5.43]	0.82 [0, 1.64]	0.82	3.28 [0.82, 7.62]	2.46 [0.41, 3.28]
Stand sniff handler	0.82	*	*	0 [0, 1.23]	*	0 [0, 1.64]	0 [0, 1.23]
Subordinate	*	*	*	0 [0, 1.23]	*	0 [0, 0.82]	*
Walk look	*	1.64 [0, 1.64]	0.82 [0, 2.05]	0 [0, 1.23]	*	1.64 [0, 2.46]	1.64 [0, 4.51]
Walk look else	3.28	3.28 [0, 1.64]	3.28 [1.23, 4.72]	0 [0, 1.23]	0.82	1.64 [0.82, 2.58]	0 [0, 1.23]
Walk look Kong	1.64	0 [0, 1.64]	*	*	*	*	*
Walk nose up	2.46	1.64 [0, 4.10]	0.82 [0, 6.15]	1.64 [0.41, 2.87]	*	1.89 [0.82, 3.28]	2.46 [1.64, 3.28]
Walk sniff	3.28	6.56 [5.74, 12.30]	4.92 [1.74, 9.43]	15.57[11.48, 20.90]	13.93	6.56 [6.56, 8.82]	6.56 [3.69, 9.43]
Walk sniff else	1.64	0 [0, 0.82]	1.64 [0, 1.81]	0 [0, 1.23]	*	1.64 [0.82, 2.58]	0 [0, 1.23]

[δ] = no inter-quartile range for this dog. N = number of sessions each dog was observed.