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The effects of past training, experience, and human behaviour on a dog's persistence at an independent task

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ABSTRACT

Past research has shown that many factors, including training history, informal experience and genetics, play a role in how certain populations of dogs behave during a problem-solving task. Less understood is how a dog's relationship with an attending human, as well as the actions of the human during the task, may affect a dog's independent problem solving behaviour. In the current study, two experiments were conducted to compare the performance and persistence of pet dogs and working dogs on a puzzle box task under a variety of conditions. In experiment one, search and rescue dogs and pet dogs were compared on the same independent task under three conditions: a neutral-human condition, an alone condition, and a human encouragement condition. No significant differences were found in the persistence of the pet dogs and search and rescue dogs (neutral-human, $p = 0.4516$; alone, $p = 0.3722$; encouragement, $p = 0.8392$); however search and rescue dogs solved the task more than pet dogs when encouraged to do so ($p = 0.038$). Pet dogs changed their behaviour depending on the human behaviour; pet dogs touched the object ($p = 0.0098$) more during the neutral-human condition compared to the alone condition. In addition, pet dogs gazed at the human ($p = 0.0016$) more during the encouragement condition. Search and rescue dogs did not show these differences in their behaviour: no differences were found across any of the conditions. In experiment two, we assessed the potential for testing-order effects by evaluating the problem solving behaviour of experimentally naive pet dogs under one of three conditions: a neutral human phase followed by human encouragement phase, human encouragement phase followed by a neutral human phase, and a neutral human phase followed by a second neutral human phase. No significant differences were found in the persistence of the dogs regardless of order of test, suggesting there were no order effects for this particular test. Our results suggest that factors such as human behaviour and training history may influence canine problem solving performance, however these effects may be limited in certain contexts.

1. Introduction

Canis lupus familiaris, the domestic dog, is one of mankind's oldest companions. Today there are as many as 700 million dogs worldwide, a tenth of the total human population (Macpherson et al., 2013). Although the majority of dogs are free-roaming, around a quarter of all dogs are companion animals, living as pets or employed in working environments (Coppinger and Coppinger, 2001). A dog's ability to be trained by and to communicate with humans is an important aspect of their welfare and success, as most dogs that live in conjunction with humans will experience some formal or informal training during their lifetime (Bekoff and Byers, 1998; Hiby et al., 2004; Plec, 2013; Udell et al., 2009). Many working dogs have been specifically bred and trained to perform certain tasks at the highest level possible (Udell et al., 2008a,b). Therefore, the ability to identify variables that might predict the training or working success of a dog, training environment or specific training methods has great value, especially for working populations.

Some research has suggested that breeding history or selection (either genetic or lifetime) for certain working roles is a reliable predictor of differences in dog behaviour, cognition or trainability, although results have been mixed (Dorey et al., 2009; Gácsi et al., 2009a,b; Helton and Helton, 2010; Mehrkam and Wynne, 2014; Shimabukuro et al., 2015; Svartberg, 2002, 2006; Turcsán et al., 2011; Udell et al., 2014; Vas et al., 2005). For example, Gácsi et al. (2009a,b) found that dogs bred to be cooperative workers, such as Border Collies and German Shepherds, perform better at following human pointing gestures compared to dogs bred to be independent workers, such as Bloodhounds and Beagles. In addition, the researchers found that brachycephalic breeds outperformed dolichocephalic breeds on pointing tasks. Likewise, Udell et al. (2014) found that working breeds, such as Border Collies and Airedale Terriers, bred to conserve or exaggerate the

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'orient-eye-stalk' component of their predatory motor sequence outperformed livestock guarding dogs, bred for an inhibition of behaviours associated with the predator motor sequence, on human pointing tasks. However, in some cases perceived differences may be influenced in part, or in whole, by owner expectations of a certain breed or dog classification (Jakovcevic et al., 2010) which can in turn influence future training, human-dog interactions, and cognitive development (Udell et al., 2008a,b).

Consequently, research focused on the effects of relationship type and training history between a dog and its owner, and especially the relationship to and behaviour of any human present during a task may be just as critical as research investigating the effects of breed type on cognition and behaviour. Owner or experimenter behaviour has been demonstrated to have a significant influence on how the dog behaves within the context of at least some cognitive studies, a finding of importance for both applied work and future experimental design (Hoummady et al., 2016; Marshall-Pescini et al., 2013; Shimabukuro et al., 2015; Udell, 2015). Marshall-Pescini et al. (2013) found that when dogs were presented with an unsolvable task that had previously been solvable, there was an increase in the alternation of gazes between the human and the apparatus. When experimenters altered their attentional states (by looking at the container and making eye contact with the dog when the dog looked at them or by turning their back on the container and dog), the researchers found that dog's displayed less gaze alternation when the experimenter was no longer facing towards the container. This suggests that dogs, like toddlers, may use gazing as a way of communicating with humans and that they can alter their behaviour based on whether the human is "paying attention" or not (Marshall-Pescini et al., 2013; Shimabukuro et al., 2015; Udell, 2015).

A number of other factors may affect how a dog problem-solves, including prior training experience (Marshall-Pescini et al., 2009, 2008; Scandurra et al., 2015), early developmental experiences (Cairns and Werboff, 1967; Udell and Wynne, 2010) and current living conditions (Clarke et al., 1951; Horn et al., 2013a,b; Marshall-Pescini et al., 2008; Svartberg, 2002; Topál et al., 1997; Udell and Wynne, 2010). Research has also demonstrated that the immediate behaviour of the human experimenter can sometimes influence a dogs' behaviour during an experimental test, particularly if the experimenter is familiar to the dog (Kerepesi et al., 2015; Prato-Previde et al., 2007; Udell, 2015; Udell et al., 2008a,b). For example, Udell (2015) found that dogs that were presented with a difficult problem-solving task (a puzzle box) increased the amount of time they spent physically interacting with the box when they were encouraged to do so by a human in the room.

To date, the great majority of research on dog cognition has focused on socio-cognitive tasks, where the dog is required to reference a human to solve a problem (Lakatos et al., 2012; Merola et al., 2012; Prato-Previde et al., 2007) or where dogs are able engage in social learning by watching a human demonstrator solve a problem (Pongrácz et al., 2001, 2004; Range et al., 2009). Research of this type is critical to our understanding of dogs' ability to effectively utilize human social cues, but does not provide information about how dogs might approach a problem in the absence of a human or human demonstration. There is a need for more research on independent problem solving behaviour of domestic dogs, as well as research aimed at identifying variables that might influence a dog's problem-solving performance and persistence when the solution to the problem is not social in nature. Closer to this aim is a body of research on unsolvable tasks, where the response towards a human is measured when no independent solution to a problem exists (D'Aniello et al., 2015; Marshall-Pescini et al., 2013; Passalacqua et al., 2013). However, the absence of a viable non-social solution in this literature has often led to the assumption that failure to persist is the logical response, although it is difficult to know whether the dog actually perceives such a task as impossible or not (Udell, 2015). Furthermore, such methods do not allow for the evaluation of independent problem-solving effectiveness, since the task cannot be solved even if the dog does persist.

Given that persistence is an important factor in problem-solving ability (Chow et al., 2016), the objective of the current investigation was to determine how training history, owner behaviour, and testing order influence how pet and search and rescue dogs behave (persistence, gazing behaviour, and overall success) during an independent problem-solving task in the presence and absence of a human when the task is solvable. We predicted that given their training to work in both independent and social contexts, search and rescue dogs would persist more at the task in general and gaze more towards their owners (when present) than pet dogs. We also predicted that testing order would affect the persistence rate and success of dogs at an independent task, with human-neutral sessions following an encouragement phase resulting in more persistent behaviour.

1.1. Study 1: A Comparison of Search and Rescue & Pet Dogs

The purpose of Study 1 was to compare the problem solving performance and persistence of search and rescue dogs and pet dogs when given a solvable puzzle box task under three different conditions: 1) when in the presence of a human behaving neutrally (human neutral), 2) when alone, and 3) when encouraged by a human. Unlike most pet dogs, search and rescue dogs are trained to work independently. Therefore we predicted that this group would excel at an independent task compared to pet dogs, regardless of what their caretaker was doing during the task (Marshall-Pescini et al., 2009). However, similar to past research that identified that water rescue dogs gaze more towards people during an unsolvable task (D'Aniello et al., 2015), we predicted that search and rescue dogs would also gaze more at their owner during the task compared to untrained pet dogs (Udell, 2015).

Past research has also shown that for pet and shelter dogs the amount of time spent touching the object increases when a dog is verbally encouraged by their owner to engage with a task (Udell, 2015). In some cases the mere presence of a dog's owner has been found to increase object manipulation or task persistence, possibly as a product of the secure base effect (Horn et al., 2013a,b); however results in the presence of a neutrally behaving owner have been mixed (Udell, 2015). Therefore, we predicted that dogs would persist the most during the encouragement phase and persistence the least when alone, regardless of whether they were working dogs or pet dogs.

1.1.1. Subjects

Two distinct groups of domestic dogs were compared: a working group of 28 search and rescue dogs (median age of four years, 14 female and 14 male) and 31 pet dogs (median age of four years, 15 females and 16 males). Search and rescue dogs were used as a comparison to pet dogs because they are traditionally trained to work independently from their owner. The search and rescue dogs were all officially certified by the state of Oregon (through the Oregon State Sheriff's Association), the United States (through the Federal Emergency Management Association), or both for scent detection on the ground, in the air, or both. All search and rescue dogs had varying levels of field experience, from six months to over 10 years. The dogs in both groups were from a variety of breeds (see Table 1), 19 different pet dog breeds and 15 different search and rescue dog breeds were tested (breeds were reported by the owners). Dogs were recruited at random from the community through online advertisement and word of mouth; data from ten pet dogs from Udell (2015) was also used in the analysis. Whether the task was solved or not was live-coded for all dogs. Trials were also video-taped for later coding of persistence and gazing at the human, however due to a video recording failure this additional analysis was only possible for 20 search and rescue dogs and 30 pet dogs.

1.1.2. Methods

Methods were based on Udell (2015). All dogs were given a puzzle box (the "object"): a Rubbermaid deep square TakeAlongs® tupperware container (51.8 × 17.3 × 13.5 centimeters, Rubbermaid item model

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