THE EFFECTS OF DELAYED POSITIVE REINFORCEMENT ON LEARNING IN DOGS

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ABSTRACT

Domestic dogs (*Canis familiaris*) have lived closely with humans for thousands of years. Successful dog training is important for dogs to fulfil the many roles that they play within human societies, and to aid good human-dog relationships and thus the welfare of both parties. The overall aim of this thesis was to investigate the interactions that take place between humans and dogs during training, with a particular focus on the timing of positive reinforcement delivery.

The first two studies examined sources of dog training information. Dog owners and trainers rated their own personal experiences as being the most valuable source of dog training information, followed closely by free or low-cost resources such as books, discussions with other owners or trainers, and the Internet. The second study examined the content of five popular dog training books, and found that some of the information on aspects of learning theory and human-given cues presented in these books was supported by academic literature; however, inconsistencies were found across the books. Not all of the books contained enough information to enable readers to replicate their training advice.

The third study in this thesis used video observations of owners and their dogs at dog training clubs to investigate the timing of positive reinforcement during training. Dogs failed to respond to 44.20% of their owners' commands. Typically, conditioned reinforcement (e.g., verbal praise) was delivered first (average delay was 0.62 s), followed by unconditioned reinforcement (average delay was 0.98 s). This suggests that delayed reinforcement is commonplace in real-life dog training.

Study four examined the effects of delays on dogs' learning in a laboratory setting. When unconditioned positive reinforcement was delayed by 1 s, only 25.00% of dogs learned the task, whereas 60.00% of dogs who received immediate unconditioned reinforcement learned. Forty percent of dogs who received immediate conditioned reinforcement and unconditioned reinforcement delayed by 1 s, learned the task. These findings show that dogs' learning is affected negatively by delayed positive reinforcement.

The final study aimed to determine how dogs are able to learn in everyday dog training situations if delayed positive reinforcement is both a common occurrence and detrimental to dogs' learning. Observations of owners training their dogs revealed that owners gave signals in the form of body movements such as hand gestures prior to providing any intentional feedback (e.g., verbal praise) to their dogs in 75.26% of trials (average delay was 0.31 s), which may bridge the temporal gap between dogs' responses and delayed reinforcement, thus aiding dogs' learning.

Overall findings from this thesis suggest that delays to positive reinforcement are detrimental to dogs' learning. Advice to dog owners and trainers should emphasise speed and consistency when delivering feedback to dogs.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1: GENERAL INTRODUCTION

Domestic dogs (*Canis familiaris*) are the first animal to have been domesticated and have been living closely with humans for thousands of years (Marshall-Pescini & Kaminski, 2014; Miklósi, 2007; Rossi, Smedema, Parada, & Allen, 2014). Dogs are a social species with a well-developed repertoire of communicative behaviours, including visual, auditory, and olfactory signals (Bradshaw & Nott, 1995).

Dogs have become a part of most human societies around the world (Clutton-Brock, 1995; Miklósi, 2007). There are over 530,000 registered dogs in New Zealand, living in approximately 30% of households (Department of Internal Affairs, 2014; Mackay, 2011). The close relationship between humans and dogs has led to dogs assuming many different roles. Dogs have traditionally been used for hunting, protection, and herding (Clutton-Brock, 1995; Rossi et al., 2014), while more-recently they have also been employed in activities such as biosecurity, policing, search and rescue, and conservation (Browne, Stafford, & Fordham, 2006), among many others. Dogs are also kept as companion animals in many countries; strong bonds are frequently formed between humans and their pet dogs, and dogs are often considered as members of the family (Albert & Bulcroft, 1988).

Attitudes to dogs differ across countries and across cultures; and not all people living alongside dogs develop close bonds with, or engage in the training of, those dogs (Serpell, 1995). However, from the perspective of humans who do associate with dogs closely, for dogs to fulfil their roles as both working and companion animals, a certain amount of training is generally required. Training

dogs is reliant in a large part on being able to communicate intentions to them successfully and then to reinforce or punish the dogs' resulting behaviours appropriately. As such, clear interspecific communication is essential to maintain harmony in both working and companion relationships.

Dog Behaviour Problems and Welfare

Dog training also affects aspects of dog welfare. Undesirable dog behaviours (e.g., aggression, hyperactivity, destructive behaviour) increase the likelihood of owners relinquishing their dogs, and most dogs taken to animal shelters are surrendered because of perceived behavioural problems (Diesel, Brodbelt, & Pfeiffer, 2010; Patronek, Glickman, Beck, & McCabe, 1996; Wells & Hepper, 2000). Once at a shelter facility, approximately one third of dogs are euthanized in some Western countries (Marston & Bennett, 2003; Patronek, Glickman, & Moyer, 1995). Some research suggests a link between dog training and a lower incidence of behavioural problems. For example, Kobelt, Hemsworth, Barnett, and Coleman (2003) found that dogs who had received obedience training were more likely to obey commands than untrained dogs, and that obeying commands was negatively correlated with the occurrence of behaviour problems. Owners who have undertaken some form of training with their dogs report that their dogs are less disobedient and participation in training activities, including discussing training and reading training books, is associated with a lower frequency of certain dog behaviour problems, including aggression (Arhant, Bubna-Littitz, Bartels, Futschik, & Troxler, 2010; Bennett & Rohlf, 2007; Jagoe & Serpell, 1996). Thus, if successful training can improve owner-dog relationships then fewer dogs may be relinquished – with the potential to save the

lives of many dogs. There are a number of communicative elements involved in dog training (Mills, 2005), and successful training relies on effective information transfer between the trainer and the dog. An understanding of how humans and dogs communicate could thus contribute to successful dog training.

Human-dog Communication

Communication can be defined as when information passes from a sender to a receiver, usually to the benefit of the receiver (Goodenough, McGuire, & Jakob, 2010). Dogs are very good at responding to human communicative cues such as pointing, attentional state indicators, and verbal information. Various explanations for these skills have been proffered, including selective pressures placed upon dogs during the domestication process (for discussions see Hare & Tomasello, 2005; Kaminski & Nitzschner, 2013; Reid, 2009). Regardless of the mechanisms behind this successful interspecific communication, dogs' abilities to respond to a wide variety of human communicative cues have been demonstrated in an extensive body of research.

Two-way object choice tests require animals to use human-given communicative cues to move towards one of two locations, where food may be hidden. The basic procedure is for a human demonstrator to stand equidistant between and slightly behind two items, such as bowls, with a dog facing the demonstrator. Any hidden food is secreted in the bowls prior to the dog facing the demonstrator. The demonstrator then gestures towards one of two bowls and the dog's response to this signal – i.e., movement towards the indicated direction – is recorded. A large number of studies have used this basic procedure (albeit with some variations) and have shown dogs' abilities to follow a variety of ostensive

gestures successfully. For example, Soproni, Miklósi, Topál, and Csányi (2002) examined dogs' abilities to follow a variety of pointing gestures to obtain food. They found that dogs would follow ordinary pointing gestures regardless of the direction of the arm movement, but not 'pointing' with sticks, or 'elbow pointing' when the upper arm and elbow (only) protruded from the side of the body. Dogs did not follow pointing gestures where the contralateral arm was held across the experimenter's body with the hand held in front of the midline of the researcher's body, but when this gesture involved the hand being extended further so that it protruded past the side of the researcher's body then the dogs did follow these points. Similar results, with dogs responding successfully to human-given pointing cues to locate food, have been produced elsewhere as well (e.g., Gácsi, Kara, Belenyi, Topál, & Miklósi, 2009a; Gácsi, McGreevy, Edina, & Miklósi, 2009b; Hare & Tomasello, 1999; Ittyerah & Gaunet, 2009; Lazarowski & Dorman, 2015). In addition to this, Udell, Dorey, and Wynne (2010) demonstrated that dogs can follow referential pointing when no food is hidden, thus removing any potential for olfactory cueing. More subtle human referential gestures, such as nodding, bowing, head-turning, glancing (eye movement only – no head movement), and gazing, can also be used by dogs as cues indicating food location (Miklósi, Polgárdi, Topál, & Csányi, 1998; Soproni, Miklósi, Topál, & Csányi, 2001).

It should be noted that there is considerable variation in the ability of individual dogs to respond to some of these human communicative gestures, with not all dogs responding to the cues (e.g., Gácsi et al., 2009a; Hare & Tomasello, 1999; Miklósi et al., 1998). Inherent breed differences, such as artificial selection for particular traits in different working breeds, may account for some of this

variation. For example, dogs from ‘cooperative worker’ breeds (e.g., herding and gun dogs) were significantly better at following human-given pointing cues than those from ‘independent worker’ breeds (e.g., livestock guarding, sled, and earth dogs) or mongrels (Gácsi et al., 2009b); and New Guinea Singing Dogs (an ‘ancient’ breed) followed pointing cues less successfully than a group of ordinary-breed domestic dogs (Wobber, Hare, Koler-Matznick, Wrangharn, & Tomasello, 2009). Phenotypic differences may also account for some of this variation. Brachycephalic (‘short-nosed’) breeds follow points more successfully than dolichocephalic (‘long-nosed’) breeds (Gácsi et al., 2009b). It has been shown that larger dogs can perform better in pointing tasks than smaller dogs, likely attributable to greater inter-ocular distances and resulting greater stereopsis (depth perception) and thus maybe an improved ability to detect visual cues (Helton & Helton, 2010). Learning across repeated trials has been suggested as another explanation for not all dogs responding successfully to pointing and other communicative cues. However, evidence for such learning is supported by some results (Soproni et al., 2001; Udell et al., 2010), but not by others (Gácsi et al., 2009a; Lazarowski & Dorman, 2015). Regardless of the variation observed across individual dogs’ abilities to utilise human communicative cues, the overriding conclusion is that dogs, in general, respond to such cues with significant success.

Dogs behave in different ways according to humans’ attentional states. A study by Call, Bräuer, Kaminski, and Tomasello (2003) found that dogs were significantly less likely to take a forbidden piece of food when a person was watching them compared to when the person was out of the room, turned their back, was distracted, or had their eyes closed. Dogs also show awareness of humans’ attentional states in other ways. Research has found that dogs obey

commands better when they are the focus of their owners' attention, compared to when their owners are directing their attention elsewhere; they will preferentially beg for food from an attentive versus an inattentive human; and dogs will take objects to the front of a person who is facing away (Gácsi, Miklósi, Varga, Topál, & Csányi, 2004; Schwab & Huber, 2006; Virányi, Topál, Gácsi, Miklósi, & Csányi, 2004).

Dogs are also sensitive to human-given auditory signals. Fukuzawa, Mills, and Cooper (2005a) trained dogs to respond reliably to basic commands and then manipulated parts of the commands' sounds (i.e., "sit" was altered to "CHit" and "siK"). They found the dogs' performance decreased significantly, indicating that even relatively small changes to a command word can impair the expected response. High rates of responding to spoken commands have also been shown to decline when the same commands are reproduced via a tape recording (Fukuzawa, Mills, & Cooper, 2005b). Dogs are responsive to the emotional content of verbal commands. When dogs are commanded to leave a piece of food, they are slower to take the food when the command has been issued in an 'angry' tone of voice compared to a 'happy' tone (Ruffman & Morris-Trainor, 2011). Further, both adult dogs and puppies have also been found to be able to use the direction of an experimenter's voice as a referential cue to locate hidden food (Rossano, Nitzschner, & Tomasello, 2014).

As well as being able to read and respond to a variety of human-given cues, dogs are also able to give their owners informative signals. Miklósi, Polgárdi, Topál, and Csányi (2000) designed an experiment in which dogs, in the absence of their owners, watched food being hidden where they could not access it. When their owners returned the dogs displayed a significant increase in mouth

licking, vocalisation, and sniffing behaviours compared with control conditions, as well as a higher frequency of gazing towards both the owners and the food location. All of the owners could correctly locate the hidden food. This study emphasises the level of interspecific communication that can take place between humans and dogs.

Taken together, these studies illustrate how keenly attuned dogs are to human behaviour; dogs are able to interpret a wide range of human communication modalities in referential terms. Because dogs are so receptive to human communicative cues it is logical to assume that human-dog communication plays some role during the dog training process, and that the communicatory feedback provided by owners during training may affect dogs' learning.

Learning Theory and Dog Training

Dogs are trained to perform various tasks through the application of learning principles, namely classical and operant conditioning.

Classical Conditioning

Pavlov's dogs salivating at the sound of a bell (or the appearance of a visual stimulus; Domjan, 2005) is the most famous example of classical conditioning. Classical conditioning involves bringing the elicitation of an involuntary response (i.e., a reflex, or an emotion such as fear) under the control of a stimulus that previously had no association with that response. By pairing an arbitrary stimulus (e.g., a bell) repeatedly and contiguously with the stimulus (e.g., meat powder) that naturally evokes the unconditioned response (e.g., salivation) an association will be formed, and the previously-neutral stimulus

becomes the conditioned stimulus that elicits what is now termed the conditioned response (e.g., salivation; Pierce & Cheney, 2013).

Classical conditioning occurs often in dog training and both positive and negative associations are made via this associative process. For example, a specific cupboard door that is always opened before feeding can start to elicit salivation and excitement from dogs, whilst a loud noise heard during eating could result in a dog becoming fearful around their food bowl. Classical conditioning mechanisms are used in behaviour modification procedures such as counter conditioning (e.g., Overall, 2013), but arguably one of the most significant applications of classical conditioning to everyday dog training is in the establishment of conditioned reinforcers, such as verbal praise or clickers (see *Unconditioned and conditioned reinforcers*, below).

Operant Conditioning

Operant conditioning differs from classical conditioning in that it entails providing a consequence after an animal has emitted a voluntary (i.e., non-reflexive) response to either increase or reduce the likelihood of that behaviour reoccurring. Positive reinforcement is the application of a stimulus (usually desirable, e.g., appetitive) in order to increase the probability of a behaviour; negative reinforcement is the removal of a stimulus (normally aversive, e.g., a loud noise) and subsequently the rate of behaviour increases. The application of a stimulus (aversive) in order to decrease the frequency of behaviour is termed positive punishment; negative punishment is the removal of a stimulus (desirable) in order to reduce the rate of behaviour. Stimuli can only be defined as reinforcers or punishers if they result in an increase or decrease in behaviour, respectively (Pierce & Cheney, 2008).

Operant conditioning is used extensively in dog training, and is employed to train most everyday behaviours. Positive reinforcement in particular is advocated frequently in modern dog training (e.g., Dunbar, 1996; McConnell, 2002; Yin, 2010), and is the basis for procedures such as shaping and chaining that are commonly used when teaching dogs new behaviours. Positive reinforcement makes use of both unconditioned and conditioned reinforcers, and there are several variables that affect the efficacy of this training technique.

Unconditioned and conditioned reinforcers. Unconditioned reinforcers are inherently reinforcing stimuli. They often fulfil biological needs and include things such as food, water, sex, and comfort (Mazur, 2001). Conditioned reinforcers are previously-neutral stimuli that have been associated with an unconditioned reinforcer via a classical conditioning process (Pierce & Cheney, 2013), thus gaining the ability to function as a reinforcer (Catania, 1998). Both unconditioned and conditioned reinforcers are used frequently in dog training. Conditioned reinforcers play a large role in training situations when it is not possible or practical to present an unconditioned reinforcer, such as when working at a distance from an animal. The conditioned reinforcer is a temporary substitute for the unconditioned reinforcer, which follows afterwards (Lindsay, 2000).

Food is frequently used as an unconditioned reinforcer in dog training, and it functions as a very effective reinforcer for dogs (Fukuzawa & Hayashi, 2013). Using food as reinforcement in real life dog training situations requires the human trainer to dispense the food by hand. Hand delivery of food may result in slow or variable timing in terms of when the food is given to the animal (Skinner, 1951; Johnston & Pennypacker, 1993, as cited in Yin, Fernandez, Pagan, Richardson, & Snyder, 2008).Verbal praise (e.g., “good dog”) is commonly given during dog

training. The (limited) research on the use of verbal feedback during dog training supports the idea that it functions as conditioned reinforcement and as such, does require continued pairing with an unconditioned reinforcer to maintain its effectiveness (Pierce & Cheney, 2013). McIntire and Colley (1967) trained dogs to perform basic behaviours using verbal praise and patting together as positive reinforcement, or verbal praise alone. Their results showed that the dogs' response latencies were increased when they received verbal praise only, indicating that it was a less effective reinforcer. Feuerbacher and Wynne (2015) used concurrent choice and single choice procedures to investigate both shelter dogs' and owned dogs' preferences for verbal praise compared to patting. A clear preference for patting over verbal feedback was observed across both groups of dogs – even when dogs' owners were providing the verbal praise. When verbal praise was the only interaction available, dogs spent no more time in the vicinity of the experimenter than compared to situations in which the experimenter provided no feedback. The authors suggested that verbal praise may not have been functional in a training context without regular association with reinforcers such as food.

Influences on the effectiveness of positive reinforcement. There are a multitude of factors that impact on the effectiveness of positive reinforcement, including magnitude and quality of the reinforcer, motivating operations, and schedules of reinforcement, among others (Mazur, 2001; Pierce & Cheney, 2013). Timing of the delivery of positive reinforcement is another important factor. Temporal contiguity between a response and reinforcement is considered to be important during learning; and delayed reinforcement is generally regarded as being less effective at conditioning an operant response (Bouton, 2007; Catania, 1998).

Delayed positive reinforcement. The effects of delayed reinforcement have been demonstrated in species other than dogs, and operant experiments have shown that some animals can learn new tasks even with quite lengthy delays to reinforcement. For example, rats can learn to press levers with delays ranging from 2 to 32 s (Byrne, Sutphin, & Poling, 1998; Dickinson, Watt, & Griffiths, 1992; Lattal & Gleeson, 1990), and break a photoelectric beam with delays of 4 and 10 s (Schlinger & Blakely, 1994). Pigeons will learn to peck keys with delays of 10 and 30 s (Lattal & Gleeson, 1990), and Siamese fighting fish learned to swim through a ring with delays of 10 and 25 s (Lattal & Metzger, 1994). Despite some animals being able to learn new tasks with such delays to reinforcement, not all animals exposed to these delays do learn, and the delays can affect the animals' task acquisition times and rates of responding. As delays to reinforcement increase, the time taken for animals to learn such tasks also increases (Byrne et al., 1998; Schlinger & Blakely, 1994). Response rates also appear to be affected by delays to reinforcement – with response rates decreasing as delays lengthen (Byrne et al., 1998; Dickinson et al., 1992; Lattal & Gleeson, 1990; Lattal & Metzger, 1994).

The only known published research on the effects of delayed communication between humans and dogs was conducted by Yamamoto, Kikusui, and Ohta (2009). The authors examined the effect of delaying both commands and consequences (reinforcement or punishment) on dogs' responses to familiar commands. Each owner was positioned in one room and their dog in another room, and audio visual equipment was used to project a life-sized image of the owner into the dog's room, with speakers projecting the owner's voice. Owners were asked to command their dogs to perform 'sit' and 'down' responses, and the

equipment was able to insert delays in between the owners issuing commands and consequences (verbal reinforcement or punishment) and the dogs receiving that information. The delayed conditions caused a mismatch between the dogs' and owners' responses. Very small delays (0.5, 1.0, and 2.0 s) resulted in significant declines in the dogs' responses to commands compared to the non-delayed condition: with longer delays the owners had to give more commands to get the dogs to obey, and the dogs took longer to respond to commands.

The timing of reinforcement is one factor that the use of conditioned reinforcers is purported to mitigate. Using a conditioned reinforcer may result in more rapid feedback being delivered to a dog as opposed to using only an unconditioned reinforcer such as food, which is typically delivered by hand (Skinner, 1951).

Clicker training. A popular tool for dog training is the 'clicker'; it is a small hand-held device that produces a distinctive clicking sound and is used as a conditioned reinforcer. Proponents of this method claim that using a clicker provides more accurate feedback to the dog when they have performed a desired behaviour, facilitating faster task acquisition (Pryor, 2009). Limited research has been published on the use of clicker training in any domestic species, despite its increasing popularity among dog owners and the establishment of many clicker-training classes for pet owners.

The only known published research examining the efficacy of using a clicker during dog training appears to be a study by Smith and Davis (2008). Two groups of dogs were trained to perform a novel task (nose-touching a cone) using either unconditioned positive reinforcement (food) only, or unconditioned and conditioned reinforcement (food and a click). In this study both the click and the

food were delivered mechanically; food delivery involved placing a treat in a bowl 0.7 m from the trainer and was described as being “approximately 1 s after a click” (p. 321). No significant difference was found between the two groups of dogs in terms of the time or number of trials required to train this task, indicating that the additional use of a clicker did not enhance this training. The dogs in the clicker group did take significantly longer (time and number of trials) for their responses to extinguish during extinction trials when a click was still delivered for target responses, when compared to the food-only dogs who received no feedback for responding.

A study looking at the use of conditioned reinforcement while training horses to operate a lever found that the average training times did not differ significantly between horses receiving both conditioned reinforcement (a buzzer) and unconditioned reinforcement (food), or unconditioned reinforcement only (McCall & Burgin, 2002). The results also indicated that the conditioned reinforcement did not prolong extinction of lever pressing, but that it did result in more responses when the animals were subsequently presented with a new task to learn. In a similar study Williams, Friend, Nevill, and Archer (2004) investigated the acquisition and extinction of a novel nose-touch behaviour with horses using clicker training. A 5 s delay was manually inserted between the administration of the conditioned reinforcement (click) and the subsequent hand-delivery of unconditioned reinforcement (food). No significant differences were found between horses receiving conditioned and unconditioned reinforcement versus unconditioned reinforcement only, in terms of the number of trials required for the animals to reach training or extinction criterion.

Contrary to the research with horses, Langbein, Siebert, Nuernberg, and Manteuffel (2007) showed that an auditory stimulus (tone) paired with unconditioned reinforcement (water) presented to goats when learning new shape discriminations resulted in fewer trials to criterion and significantly higher daily learning success, when compared to the provision of unconditioned reinforcement alone. This experiment employed fully-automated apparatus and thus all reinforcement delivery was well controlled – more in keeping with laboratory-based procedures than applied settings.

The current research examining clicker (and other auditory stimuli) use during training with a range of domestic species has thus far produced conflicting results in terms of how they affect animals' learning. There is an inherent difficulty in controlling all of the variables in applied (vs. laboratory) situations (Langbein et al., 2007; McCall & Burgin, 2002; Smith & Davis, 2008; Williams et al., 2004); this may contribute to such results.

Summary

Dogs are expected to fulfil a wider variety of roles than any other non-human animal species, ranging from farming, to protection, to scent-detection, as well as living as a companion animal in a large proportion of many societies. Factors such as effective communication between humans and dogs, as well as the particular methods of training used, can impact on training outcomes. Successful dog training helps dogs to maintain good working and companion relationships; hence, investigations into efficacious training methods are of particular importance to the field of dog research.

Dogs' responsiveness to human-given communicative cues has been established by a significant body of research. Dogs can follow ostensive gestures such as pointing, head turning, and gazing to find hidden food (Miklósi et al., 1998; Soproni et al., 2001). Dogs adjust their behaviour in response to humans' attentional states, including being more likely to steal food when people are not watching (Call et al., 2003; Virányi et al., 2004), and in response to variations of verbal commands, such as pronunciation and tone of voice (Fukuzawa et al., 2005a; Ruffman & Morris-Trainor, 2011).

Positive reinforcement is employed frequently in everyday dog training, with the use of both unconditioned and conditioned reinforcers being common. Research on other species has shown that when positive reinforcement is delayed, animals' performances can be impaired: they often take longer to learn a novel task, and their rates of responding can be lower (Byrne et al., 1998; Schlinger & Blakely, 1994). The effects of delayed reinforcement on dogs' learning have not yet been examined.

Because successful training involves effective communication, as dogs are so sensitive to human communicative cues, and since the timing of some feedback (such as positive reinforcement) can impact on learning, it is reasonable to assume that all of these factors have a measure of influence on the efficacy of dog training. Thus, this research endeavoured to examine these factors. The overall aim of this thesis was to examine how communication between dogs and humans affects the success of dog training, with particular attention paid to human-given feedback provided during training.

Following this General Introduction, Chapter 2 comprises two studies. The first was a small scoping study involving interviews with dog owners and dog

trainers. The aim of this study was to look at where these people sourced their dog training information and which aspects of human-dog communication they believed were important during dog training. The second study was a review of popular dog training literature. The contents of five books were examined for information on learning theory and human-dog communicative cues. The aim of these reviews was to assess the accuracy of the books' contents when compared to corresponding academic literature, and to judge how well these books might function as instructional texts.

Following on from the first two studies, Chapter 3 reports a third study that involved naturalistic observations of owners training their dogs in dog training classes. This research aimed to describe the interactions between owners and dogs that occurred during training, with a particular focus on the time owners took to deliver positive reinforcement.

Given the findings in Chapter 3, the next step was to manipulate the delay to reinforcement with dogs experimentally; this is reported in Chapter 4. The aim of this experiment was to assess the effects of delays to reinforcement on dogs' learning of a novel task.

The findings from both Chapter 3, on observed delays to positive reinforcement, and Chapter 4, on the effects of experimentally-delayed reinforcement, combined to raise questions about how dogs learn in everyday circumstances. Chapter 5 reports on a fifth study in which owners were observed training their dogs at their homes. The aim of this last study was to examine the order and timing of the feedback owners provided to their dogs during a novel training task, including physical cues that might function as conditioned reinforcement.

CHAPTER 2: INTERVIEWS WITH DOG OWNERS AND DOG TRAINERS, AND A REVIEW OF POPULAR DOG TRAINING BOOKS[1]

INTERVIEWS WITH DOG OWNERS AND DOG TRAINERS

Introduction

In order for owners to be effective dog trainers, knowledge about things that might influence the success of training is valuable. Because dogs have been shown to be so receptive to human behaviour (see Chapter 1), it is reasonable to hypothesise that human-given cues may have some impact during the dog training process. For example, knowledge of the fact that dogs obey commands more frequently when they are the focus of their trainer's attention rather than when the trainer's attention is directed elsewhere (Schwab & Huber, 2006), and that some dogs are able to respond to subtle cues such as eye gazing and pointing as referential communication (Miklósi et al., 1998; Soproni et al., 2001), could be useful in an applied setting. For this reason, owners may be able to train their dogs more effectively with an understanding of how and when to use such cues during dog training.

Previous studies have demonstrated that owners acquire their dog training information from a variety of sources. Owners discuss dog training with friends or family more frequently than reading dog training books, which they reportedly do more often than attending formal training classes (Bennett & Rohlf, 2007).

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[1]The portion of this chapter reviewing popular dog training literature has been accepted for publication as Browne, C. M., Starkey, N. J., Foster, T. M., & McEwan, J. S. (*in press*). Examination of the accuracy and applicability of information in popular books on dog training. *Society & Animals.*

Visiting a free animal behaviour internet site has been rated by owners as their most preferred option for seeking help if their dogs had behaviour problems, followed by calling a veterinarian for free advice, and then buying a book (Shore, Burdsal, & Douglas, 2008). Owners of dogs with existing behavioural problems have reported 'self' as the source of most of their behavioural interventions, followed by 'trainers' (Herron, Shofer, & Reisner, 2009).

The goal of the current study was to examine training information in a New Zealand context via a small scoping study. In this study dog owners and trainers were interviewed about dog training. The aim of this study was to assess the importance people place on different sources of dog training information and human-given communicative cues during dog training.

Method

Study participants were dog owners and dog trainers in the Waikato region, New Zealand, recruited through direct approach, personal contacts, and word of mouth. Ten people participated in this study: five dog owners and five dog trainers. The participants were a median age of 30 years, ranging from 23 to 62 years. Seven of the participants were female and three were male. The participants had a variety of dog ownership experience, from having owned one to 25 dogs, over time periods of one to 30 years.

Approval for this study was gained from the Psychology Research and Ethics Committee, School of Psychology, University of Waikato (approval number #09:20). Participants were provided with an information sheet describing the background of the study and the procedure prior to the interviews, and given

the opportunity to ask questions of the researcher. All participants signed a consent form before the interviews commenced.

Participants were interviewed in person at a location of their choosing or over the telephone. Responses were recorded on an iriver® iFP-799 MP3 player and were written on a copy of the interview questions.

The participants completed a structured interview consisting of 18 questions (see Appendix A for a copy of the questions). Demographic information, including ownership and training history, was collected. These questions were designed in accordance with other research on people's opinions on dog training and behaviour (Blackwell, Twells, Seawright, & Casey, 2008; Hiby, Rooney, & Bradshaw, 2004).

Participants were questioned about different sources of dog training information they had used to learn about training dogs, and which aspects of human-dog communication (based on cues described in scientific literature) they thought were important during dog training. These questions included two rank ordering questions (Iarossi, 2006) that were intended to directly address the aim of this scoping study, as well as open-ended questions to provide additional contextual information. To ensure the questions were clear, they were tested on a non-participating dog owner prior to the study commencing.

The interviews took approximately 30 minutes to complete. All participants' responses were kept anonymous.

Data analysis

The rank ordered data regarding dog training information sources and human-given cues were summarised in tables to facilitate interpretation. Results are described in terms of total ranked importance.

Results

The objective of this study was to examine the importance people place on dog training information sources and human-given cues, thus these data are the focus of the results.

Dog Training Information Sources

'Personal experience' was given the highest total ranking out of all the potential dog training information sources (Table 2.1). This was followed by 'books', 'talking to dog owners', 'internet websites' and 'talking to dog trainers', 'television shows', and 'dog obedience classes'.

Human-given Cues

'Tone of voice' received the highest total ranking of all the cues (Table 2.2). 'Eye contact' was considered the next most important cue, and then 'hand gestures'. 'Pronunciation' and 'proximity' had somewhat lower rankings; and all other cues were ranked below these.

Discussion

The results showed that participants placed differing importance upon sources of dog training information and the use of various human-given communicative cues during dog training, with some variation noted across participants' responses.

Dog Training Information Sources

The participants reported that they had learned more about training dogs from 'personal experiences' than any of the other potential sources of dog training information, followed closely by 'books'. Similar findings have been reported elsewhere (Bennett & Rohlf, 2007; Herron et al., 2009; Shore et al., 2008).

Table 2.1

The Ranked Importance of Information Sources Dog Owners and Trainers Have Used to Learn About Dog Training, Presented Overall

Participant	Personal experience	Books	Talking to dog owners	Talking to dog trainers	Internet websites	Television shows	Dog obedience classes	University study	Puppy classes	Prof. seminars/ workshops	Videos/ DVDs	Polytechnic study	Consultation with prof. dog trainers
Dog owners													
2.3	13	12	9	6	7	11	10		8		5		
2.4	12	11	13	9	10								
2.5	13	11	12	10	9					8			
2.6	13	11	12		9	10							
2.9	12	9		8	7	10	11	13					
Dog trainers													
2.1	8	10	6	11	5	7	3	13	12		4	9	
2.2	13	9	12	6	8	10	5	4	7		11		
2.7	12	9	7	8	10		5		6	13		11	
2.8	10	8	11	13	6	5	4	9		12	7		
2.10	8	13	11		12	9	10						
Total	104	97	85	80	80	69	59	38	33	31	30	20	0
Average	10.40	10.78	9.44	10.00	8.89	6.90	9.83	12.67	8.25	7.75	7.50	10.00	
Variance	9.16	4.19	5.03	2.29	5.11	6.54	6.17	0.33	6.92	16.92	8.33	2.00	

Note. Importance is ranked in descending order, from 13 (highest) to 1. Participants did not rank sources if they had not used them.

Table 2.2

The Ranked Importance of Human-given Cues Used During Dog Training as Ranked by Dog Owners and Trainers, Presented Overall

Participant	Tone of voice	Eye contact	Hand gestures	Pronuncia-tion	Proximity	Body orientation	Body position	Arm movements	Sudden sounds	Head orientation	Volume of voice	Sudden movements
Dog owners												
2.3	9	11	12	5	8	7	2	10	4	3	6	
2.4	9	11	12	10	4	8	7	5		6		3
2.5	11	8	12	9	7		6		10			
2.6	12	10	7	11	5	8	9	6	3	2		4
2.9	12	11	8	10	8	9	3	4	7	6	5	
Dog trainers												
2.1	11	7	10	5	12	9	6	2	8		3	4
2.2	8	9	10	12	4	11	1	2	3	7	6	5
2.7	11	7	8	9	12	10	4	3	5	6	2	1
2.8	12	11	6	7	8	5	10	9	4		3	2
2.10	12	11	9	10	7	6	4	8		5		
Total	105	94	90	77	75	58	54	52	46	44	43	19
Average	10.50	9.40	9.00	7.70	8.33	6.44	7.71	5.20	5.11	5.50	6.14	3.17
Variance	2.06	4.71	4.22	15.57	4.00	9.28	10.24	8.62	5.11	6.57	3.81	2.17

Note. Importance is ranked in descending order, from 12 (highest) to 1. Participants did not rank cues if they deemed them to be of no importance.

‘Talking to dog owners’, ‘talking to dog trainers’, and ‘internet websites’ also received relatively high total rankings. Previous research has indicated that owners seeking help with a dog behaviour problem are likely to turn to internet websites (Shore et al., 2008), whereas owners reporting low levels of problematic behaviours in their dogs commonly discuss training with friends or family (Bennett & Rohlf, 2007).

‘Dog obedience classes’ was ranked by six participants only, and given a median total ranking. This fits with various studies’ findings that owners’ engagement in dog obedience training ranges from 20% to over 64% (Arhant et al., 2010; Bennett & Rohlf, 2007; Blackwell et al., 2008; Kobelt et al., 2003; Rohlf, Bennett, Toukhsati, & Coleman, 2010). This may be a result of the cost of classes; dog owners have previously demonstrated a preference for free, rather than paid, sources of dog training information (Shore et al., 2008).

Human-given Cues

Participants regarded ‘tone of voice’ to be the most important human-given cue. Work by Mills, Fukuzawa, and Cooper (2005) indicates that dogs may recognise the difference between ‘gloomy’, ‘angry’, ‘happy’, and ‘neutral’ tones of voice; thus, tone of voice is something that may be useful to manipulate during training.

‘Eye contact’ received the second-highest total ranking, followed closely by ‘hand gestures’. Studies have shown that dogs are extremely responsive to human eye gazing, glancing, and attentional states, as well as pointing (Call et al., 2003; Hare, Call, & Tomasello, 1998; Hare & Tomasello, 1999; McKinley & Sambrook, 2000; Miklósi et al., 1998; Schwab & Huber, 2006; Soproni et al.,

2001, 2002); therefore the importance placed on these cues by this study's participants is supported by the experimental literature.

'Pronunciation' received a relatively high total ranking overall. Subtle changes in the pronunciation of commands have been shown to reduce dogs' responses to known commands (Fukuzawa et al., 2005a), and thus it may well have an impact during dog training. Lower total rankings were given to cues such as 'body orientation', 'body position', and 'head orientation'; however, there is evidence to suggest that these cues are noticed by dogs (Call et al., 2003; Gácsi et al., 2004; Miklósi et al., 1998; Schwab & Huber, 2006; Virányi et al., 2004).

This study was originally intended to be a scoping study, providing a starting point for subsequent research in this thesis, although the information gained from it guided the thesis away from investigating this topic more thoroughly (see *Summary*, below). As such, a convenience sample of 10 participants only was recruited, and thus the findings are limited in terms of how well they generalise to other dog owners and trainers. The questions were designed with the intention of eliciting the information required to answer the aim of this initial study, and they were not pre-validated questions.

Future research

This scoping study was not developed further; however, it would be interesting to examine this topic further by developing a full study with design modifications. These include the use of a questionnaire (rather than interviews) with closed-ended, Likert-type graded response questions (Coolican, 2014) to collect quantitative data; the use of validated questions; and recruitment of a much larger sample of participants.

Summary

Successful dog training relies in considerable part on owners and trainers being able to access good quality information. This scoping study found that, overall, participants ranked their own personal experiences as the most important information source. Assessing the accuracy of the dog training information gained through personal experiences would be difficult to do reliably – depending on participants' abilities to recall numerous events precisely over sometimes long periods of time. However, participants' second-ranked source of dog training information was books. This source can be investigated further in terms of the accuracy of the provided information in a methodical and reliable way. For this reason, the next study to follow these interviews was an examination of the information contained in popular dog training books.

REVIEW OF POPULAR DOG TRAINING BOOKS

Introduction

The previous scoping study showed that information on dog training is obtained from a variety of places, but that books are the second-most relied upon source. Because the quality of dog training information that owners access has a bearing on how effective they may be at training their dogs, it is useful to assess the content of the information that is provided in dog training books.

Dogs are trained to perform various tasks through the application of learning principles, namely classical and operant conditioning (as described in Chapter 1), whether the trainer is aware of this or not. Surveys have found that the majority of pet dog owners describe using training techniques that involve both positive and negative reinforcement and positive and negative punishment, such as giving food, verbal praise, physical manipulation into a position, 'time out', verbal reprimands, and smacking (Arhant et al., 2010; Blackwell et al., 2008; Hiby et al., 2004; Rooney & Cowan, 2011). Some of these studies have found an association between owners reportedly using only positive reinforcement training methods and a lower incidence of reported dog behaviour problems (Blackwell et al., 2008; Hiby et al., 2004). In addition, the frequency with which owners use punishment-based methods has been positively correlated with the number of behaviour problems their dogs display (Hiby et al., 2004), and higher rates of aggression have been found for dogs whose owners use a mixture of reinforcement and punishment (Blackwell et al., 2008). It is, however, important to note that these relationships have not been determined to be causal – dogs that do not display problem behaviours may simply not attract punishment. Many dog

owners have no formal training in behavioural science, thus it is important that learning principles are presented so that their relevance and application are clear. Similarly, equestrian coaches and riders often have a poor understanding of these learning principles, which is considered problematic in terms of training efficacy, safety, and welfare (McGreevy, 2007; Warren-Smith & McGreevy, 2008). Although a variety of dog training methods are commonly employed, an explanation of learning principles in books may allow owners to select and apply particular techniques relevant to their specific training situations, thus maximising training efficacy.

In addition to sound explanations of learning principles, owners may also benefit from dog training books highlighting the fact that dogs are highly responsive to aspects of human behaviour, as detailed in Chapter 1 and the *Interviews with Dog Owners and Dog Trainers* section previously. Because achieving effective communication between humans and dogs is of relevance to successful dog training, it may be useful for dog training books to advise readers on the use of communicative cues.

The purpose of this study was to select a sample of best-selling English-language dog training books and examine their content with particular regard to learning theory and human-given cues. The aim was to evaluate the accuracy and level of detail of the information given, and to compare the books with each other.

Method

Book Selection

An Internet search was performed in August 2009 for dog training books on three major online bookstores' websites: Amazon UK, www.amazon.co.uk;

Amazon US, www.amazon.com; and Fishpond, www.fishpond.co.nz. The search term “dog training” was entered, and the resulting books were sorted by “best selling” from highest to lowest.

Five books were selected for review. These books appeared the most frequently within the top 10 listed books across all three websites. If any books appeared with equal frequency, the number of other listed books by the same authors was taken into account when making the selection; i.e., books whose author also had another book in the top 10 were chosen. Books dedicated specifically to puppy- and trick-training were discounted from selection, as the aim of this review was to target books considered to be general dog training texts.

The books selected were (in order of descending popularity):

1. Millan, C., & Peltier, M. J. (2006). *Cesar's way: The natural, everyday guide to understanding and correcting common dog problems.* New York, NY: Three Rivers Press.
2. Fennell, J. (2002). *The dog listener: Learning the language of your best friend.* London, England: HarperCollins.
3. Stilwell, V. (2005). *It's me or the dog: How to have the perfect pet.* London, England: Collins.
4. Pryor, K. (1999). *Don't shoot the dog! The new art of teaching and training* (Rev. ed.). New York, NY: Bantam Books.
5. Monks of New Skete (2002). *How to be your dog's best friend: The classic training manual for dog owners* (2nd ed.). Boston, MA: Little, Brown and Company.

(Note: although this search was originally conducted in 2009, it was replicated again in 2012 and results showed that these same books remained listed

in the top 11 best-selling books across these websites. In 2014 a similar search was also performed (Amazon United States changed its website's search criteria slightly and so books from that website were ordered by 'relevance'), showing that these titles featured in the top 20 listed books on these websites (as well as several other titles by these same authors). The on-going popularity of these books suggests a noteworthy measure of influence, and that this study remains relevant and these books continue to provide a good representation of the information accessed by dog owners in recent years.)

Review Procedure

Each book was read entirely, at least twice. The general content of each book and the authors' approach to training was evaluated and summarised using a content analysis approach (looking for quantitative information, rather than themes) (Coolican, 2014; Schreier, 2014).

Elementary aspects of learning theory (particularly operant conditioning) taken from scientific literature and deemed to be particularly relevant to basic dog training were searched for. The books were examined for explanations of reinforcement and punishment, including how accurately and thoroughly these concepts were described. Definitions and examples of these concepts are in Table 2.3; descriptions falling within the scope of these definitions were considered accurate. If the authors advocated using positive and/or negative reinforcement and/or punishment, their descriptions of when or how to do this was noted, as were references to the timing of reinforcement, punishment, or commands. This information was tabulated to enable comparisons across the books. Use of classical conditioning was also recorded.

Table 2.3

The Learning Theory Definitions, as Described by Pierce & Cheney (2013), Against Which Authors' Descriptions of Training Techniques Were Compared for Accuracy

Term	Definition	Example
Positive reinforcement	Presentation of a stimulus or event after a behaviour that increases the probability of the response.	"Go outside with him and give him lots of praise and a treat when he does what he's supposed to do" (Stilwell, 2005, p. 124).
Negative reinforcement	Removal or prevention of an ongoing stimulus or event by a behaviour and subsequently the rate of that response increases.	"As you come to a stop, transfer your leash completely to your right hand, pulling up on it slightly. At the same time, with your left hand reach down and back and gently press down on Una's rear end, easing her into a sit as you say, "Una, sit"" (Monks of New Skete, 2002, p. 233).
Positive punishment	Presentation of a stimulus or event after a behaviour that decreases the probability of the response.	"When I have a dog on a leash, I'll give a little tug upward to snap the dog out of unwanted behavior" (Millan & Peltier, 2006, p. 219).
Negative punishment	Removal of a stimulus or event after a behaviour that decreases the rate of the response.	"Whenever this [dog growling at visitors] happened, I asked Steve and Debbie to get up and walk out of the room" (Fennell, 2002, p. 118).
Aversive stimulus	A stimulus that an animal avoids or attempts to escape from.	"Simply grasp her paws when the dog jumps up on you; gently move the paws slightly to the [*sic*] each side and begin moving slowly to keep the dog up on her two hind legs … the dog becomes quite uncomfortable and wants to get down" (Monks of New Skete, 2002, p. 287).
Classical conditioning	When the control of respondent behaviour is transferred from one stimulus to another by stimulus-stimulus association.	"Feed him, and then while he's eating, try snipping the scissors or clippers near him. Do this a few times. He'll begin to associate these tools with eating time, which will make for a more pleasant experience at the groomer's" (Millan & Peltier, 2006, p. 251).

The books were also examined for references to particular human-given cues, which were selected based on human-dog communication scientific literature (e.g., Fukuzawa et al., 2005a; Miklósi et al., 1998; Schwab & Huber, 2006; Soproni et al., 2001): eye contact, head or body orientation, proximity, body position, hand or arm gestures, tone of voice, volume of voice, and pronunciation. For example: "Dogs respond really well to vocal tone and pitch" (Stilwell, 2005, p. 68); and "The dog's extreme sensitivity to movement means that hand signals and gestures are often much more useful in training than spoken commands, especially if you are working at a distance" (Stilwell, 2005, p. 24). Each mention of advice on the use of these cues was recorded and this information was summarised.

All of this information was documented when it was used in discussion of dog training in general terms and when mentioned in relation to three tasks: 'sit', 'down', and 'come'. These three tasks are trained and employed by dog owners commonly, and as such clear explanations on how to train these three tasks may be useful to the majority of dog owners. Thus, it may be expected that instructions on training these tasks would be included in dog training books.

The researcher recorded the information based on definitions provided in academic literature. In order to ensure reliability, any occurrences that were unclear were discussed with other researchers to achieve a consensus; only clear instances of these constructs were included.

Results

Cesar's Way: The Natural, Everyday Guide to Understanding and Correcting Common Dog Problems

Millan's and Peltier's (2006) book, *Cesar's way: The natural, everyday guide to understanding and correcting common dog problems*, is a guide to how Millan believes owners should communicate with their dogs. Millan is a self-taught dog trainer who achieved international prominence with his United States television series *Dog Whisperer*; and this book is almost as much of an autobiography as it is about dog behaviour and training. The authors do not claim this book to be a training manual per se, but rather, its aim is to "help you understand your dog's psychology better" (Millan & Peltier, 2006, p. 197). The concept of dominance, and that owners should act as 'pack leaders', is a constant theme throughout this book. The authors' definition of a pack and the roles within it, however, are at times contradictory. For example, at different points throughout this book it is stated that a pack has only two roles ('leader' and 'follower'), that there are varying levels of status within a pack, and that all human household members should be a dog's leader.

Positive reinforcement is discussed sometimes in this book, but it is not defined clearly (Table 2.4). Millan and Peltier talk about 'corrections' in some detail, however this term may be more accurately described as positive punishment as the goal of 'corrections' appears to be to stop unwanted behaviours. For example: "If you send them to another room or put them outside, they probably won't make the connection between the banishment and the bad behaviour ... Corrections have to happen in the now – and be repeated every time the rule is broken – before a dog will understand what aspects of her behaviour are

Table 2.4

Dog Training Information Contained in Books, Discussed in Reference to All Situations Other Than Training Sit, Down, and Come Behaviours

Author	Explanation of reinforcement	Explanation of punishment	Use of R+	Use of R-	Use of P+	Use of P-	Timing of command	Explanation of classical conditioning	Use of classical conditioning
Millan & Peltier	-	x	16(5)	0	21(4)	0	0	-	4
Fennell	-	-	30(8)	1	4	10	5	-	7
Stilwell	x	-	52(22)	0	9(2)	14(3)	16	x	15
Pryor	x	x	46(11)	2(3)	7	2	1	-	0
Monks of N. S.	x	x	59(19)	1	58(27)	0	20	-	9

Note. R+ = positive reinforcement, R- = negative reinforcement, P+ = positive punishment, P- = negative punishment. These data are instances of these techniques being advocated by the authors; the numbers in brackets represents the number of times the timing of these techniques was referred to. Presence of information = x; absence of information = -.

unwanted by you" (Millan & Peltier, 2006, p. 217). And: "When I have a dog on a leash, I'll give a little tug upward to snap the dog out of unwanted behaviour" (Millan & Peltier, 2006, p. 219). The methods for changing unwanted behaviour in this book tend to rely on the use of aversive stimuli, such as jerking on the lead. It's explained that the timing of corrections is important, and that they should be delivered at the instant the undesired behaviour occurs (Table 2.4).

Millan and Peltier describe in broad terms how 'energy', a "language of emotion" (Millan & Peltier, 2006, p. 66), is the main form of human-dog communication. Human-given cues are referred to, particularly eye contact and volume of voice, but 'projecting' the correct form of 'energy' is the method of communication underscored in this book (Table 2.5). For example: "... [at the dog park] you should be on the alert, not standing in one place, but moving around the park and constantly connecting with your dog through calm-assertive voice, eye contact, and energy" (Millan & Peltier, 2006, p. 254).

The authors clearly state this book "isn't a "how-to" manual" (Millan & Peltier, 2006, p. 197), but rather it is focused on teaching owners how to understand their dogs' behaviour; and as such, no instructions are provided on how to train basic behaviours such as 'sit' (Tables 2.6 and 2.7).

The Dog Listener: Learning the Language of Your Best Friend

The author of *The dog listener: Learning the language of your best friend*, Fennell (2002), also featured in a well-known United Kingdom television series, *The Dog Listener*. Fennell developed her training philosophy through observing her own dogs and watching videos of wild canids, particularly wolves. She adheres strongly to the notion of wolves and dogs having a hierarchical social structure, and this is reflected in how she thinks dogs and people should interact.

Table 2.5

Human-dog Communication Information Contained in Books, Discussed in Reference to All Situations Other Than Training Sit, Down, and Come Behaviours

Author	Eye contact	Head / body orientation	Proximity	Body position	Hand / arm gestures	Tone of voice	Volume of voice	Pronunciation
Millan & Peltier	13	8	6	3	4	2	15	0
Fennell	9	7	7	3	3	3	13	0
Stilwell	14	11	14	10	21	9	4	0
Pryor	0	1	0	0	3	1	1	0
Monks of N. S.	18	15	12	18	18	19	18	2

Note. These data are instances of advice being given on the use of these communicative cues.

Table 2.6

Dog Training Information Contained in Books, Discussed With Reference to Training Dogs to Sit, Down, and Come

Author	Command	Use of R+	Use of R-	Use of P+	Use of P-	Timing of command
Millan & Peltier	Sit	0	0	0	0	0
	Down	0	0	0	0	0
	Come	0	0	0	0	0
Fennell	Sit	1(1)	0	0	1	1
	Down	1	0	0	0	0
	Come	6(1)	0	0	3	1
Stilwell	Sit	2(1)	0	0	1(1)	1
	Down	1(1)	0	0	0	1
	Come	2(1)	0	0	0	2
Pryor	Sit	1(2)	0	0	0	3
	Down	0	0	0	0	0
	Come	2	0	0	0	0
Monks of N. S.	Sit	4(5)	2	1	0	3
	Down	7(7)	2	2	0	6
	Come	7(3)	0	8	0	11

Note. R+ = positive reinforcement, R- = negative reinforcement, P+ = positive punishment, P- = negative punishment. These data are instances of these techniques being advocated by the authors; the numbers in brackets represents the number of times the timing of these techniques was referred to.

Table 2.7

Human-dog Communication Information Contained in Books, Discussed With Reference to Training Dogs to Sit, Down, and Come

Author	Command	Eye contact	Head / body orientation	Proximity	Body position	Hand / arm gestures	Tone of voice	Volume of voice	Pronunciation
Millan & Peltier	Sit	0	0	0	0	0	0	0	0
	Down	0	0	0	0	0	0	0	0
	Come	0	0	0	0	0	0	0	0
Fennell	Sit	0	0	1	0	1	0	0	0
	Down	0	0	0	0	0	0	0	0
	Come	1	1	2	0	0	0	0	0
Stilwell	Sit	0	0	1	0	3	0	0	0
	Down	0	0	0	0	3	0	0	0
	Come	0	2	2	1	1	1	0	0
Pryor	Sit	0	0	0	1	1	0	0	1
	Down	0	0	0	0	0	0	0	0
	Come	0	0	0	0	1	0	0	0
Monks of N. S.	Sit	0	1	0	1	2	0	0	1
	Down	2	5	1	7	6	2	0	0
	Come	3	1	3	5	4	3	0	0

Note. These data are instances of advice being given on the use of these communicative cues.

Many training situations and behaviour problems are covered in this book, during which constant comparisons are made between dog and wolf behaviour and the 'leadership' role of owners is emphasised. Anthropomorphisms, such as attributing feelings of responsibility to dogs, are common throughout this book. For example: "The dog felt that he was responsible and did not want her [the owner] to go out into a world he felt she did not understand; an Alpha, by definition of its status, knows best" (Fennell, 2002, p. 106).

Fennell does not explain learning principles or use much learning terminology, but provides many examples of positive reinforcement and several of punishment (Table 2.4). She makes frequent reference to 'making positive associations' and 'rewarding' dogs for desirable behaviour. The author recommends the use of negative punishment such as removing food and 'time outs' as consequences for undesirable behaviour, although they are not described as punishment (and in one case, the author states that removing the dog from a room for unwanted behaviour should not be perceived as punishment). Timing of positive reinforcement is mentioned, with the clearest instructions being that positive reinforcement should be delivered as the dog's rump touches the ground (when teaching sit), and "the second the dog comes" (Fennell, 2002, p. 81) (Table 2.4). In reference to toilet training, it's explained that delayed positive punishment is ineffective. In the account of teaching a dog to sit, readers are instructed to give the command with the food, after the dog has performed the behaviour (Table 2.6).

This book emphasises being calm when communicating with dogs. Fennell advocates ignoring dogs in certain situations (e.g., when reuniting with them) and specifies that a lack of eye contact, touch, and verbalisations are important when

doing this (Table 2.5). For example: “The key to this then is that the dog must not be engaged with in any way. By this I mean no eye contact, no conversation, no touching unless it is to gently push the dog away” (Fennell, 2002, p. 77).

Fennell advises luring and giving ‘rewards’ to dogs when teaching basic obedience tasks, but the level of detail provided in the instructions is variable and they are not always detailed enough to be replicated easily by a reader (Tables 2.6 and 2.7).

It's Me or the Dog: How to Have the Perfect Pet

It’s me or the dog: How to have the perfect pet by Stilwell (2005), accompanied the author’s popular United Kingdom television series of the same name. Stilwell’s background with dogs is based on practical experience: working as a dog walker, with shelter dogs, and running a dog training school. Her television programme focused on dogs who are challenging to train or that have behaviour problems. This book covers a wide range of topics from how to communicate with dogs, to recommended dog food, to teaching dogs tricks.

Aspects of operant and classical conditioning are described in this book, although classical conditioning in particular is not explained in much depth (Table 2.4). The author claims that all of her training methods are ‘positive’; however, she does advocate the use of ‘corrections’ (punishments) such as verbal reprimands and ‘time outs’ for when dogs do not respond to commands or are displaying unwanted behaviour. Timing of positive reinforcement and corrections is emphasised as being important, with the author maintaining that feedback should be delivered within one second of the dog’s response (Table 2.4).

This book stresses the importance of effective communication between dogs and owners, and gives specific directions on how owners should use their

voice and body language during training (Table 2.5). For example: “Vary your body positions. The dog should respond when you are sitting, crouching or standing, not just when you are standing and facing him” (Stilwell, 2005, p. 76).

Step-by-step instructions are provided for teaching a selection of behaviours, including how and when to use positive reinforcement (the form of operant conditioning most-frequently recommended) (Tables 2.6 and 2.7).

Don't Shoot the Dog! The New Art of Teaching and Training

Pryor’s (1999) book, *Don’t shoot the dog! The new art of teaching and training*, explains the broad principles of learning and their application in training situations. The author has years of experience in the field of animal training, particularly clicker training.

Despite its somewhat-misleading title, this book discusses methods of teaching and modifying behaviour in any species, including humans, and is not specific to dogs. There is a strong emphasis on the application of positive reinforcement to both train new behaviours and modify existing ones (Table 2.4). Pryor describes shaping techniques in detail, establishing stimulus control, and how to get rid of undesirable behaviours. The importance of timing of positive reinforcement (or punishment) is highlighted, with the author stating it should be delivered in conjunction with the behaviour in question, and that reinforcing too early or too late is ineffective (Table 2.4). These concepts are not described solely in the context of dog training.

This book is a guide to the training of any animal, and so unsurprisingly it contains little mention of human-dog communication with regards to human-given cues, and does not explicitly describe how to train dogs to perform specific behaviours (Tables 2.5, 2.6, and 2.7). For example, reference is made to teaching

a dog to sit, but it is in the context of establishing stimulus control and describing when to introduce the verbal command; the use of a hand signal, body position and pronunciation is mentioned with no explicit instructions (Table 2.5): "You can make the cue very broad: add a hand signal, body English, speak very clearly" (Pryor, 1999, p. 72). This book had no explanation on how to teach a dog 'down', and a brief reference to using a hand signal when training 'come': "We are essentially using targeting when we slap our thighs to coax a dog to us. The movement seems to attract dogs, and when they approach, we reinforce the behaviour with petting" (Pryor, 1999, p. 58).

How to be Your Dog's Best Friend: The Classic Training Manual for Dog Owners

The authors of *How to be your dog's best friend* (Monks of New Skete, 2002) have been training and breeding dogs for over 30 years in their monastery in the United States. This book, first published in 1978, covers an extensive range of topics from puppy selection to the death of a dog. The authors place emphasis on having a good owner-dog relationship, and advocate that good communication and training contribute to this. They also think that owners should take a leadership, or 'alpha', role in this relationship.

The use of both positive reinforcement and punishment are discussed frequently throughout this book (Table 2.4). The authors, whilst acknowledging the behavioural definitions of the terms positive and negative reinforcement and punishment (albeit with cursory explanations), proceed to assign their own labels to them. For example, the authors use the word 'correction' to describe "light discipline" (Monks of New Skete, 2002, p. 68) such as verbal reprimands and jerking on the lead, and 'punishment' to describe "more forceful verbal and

physical discipline" (Monks of New Skete, 2002, p. 68) such as shaking or hitting a dog. They advocate that the least amount of force necessary should always be used: "Build on your corrections, making them progressively tougher until your dog responds appropriately. Above all, watch your dog: his response will tell you whether the correction is too soft or too stern. Once you've obtained a consistent type of response, stick to that level" (Monks of New Skete, 2002, p. 70). Timing of positive reinforcement and positive punishment are mentioned regularly in this book; some of these instructions indicate giving rapid feedback, others are less specific (Table 2.4).

Human-given cues such as eye contact, specific body positions, and using particular tones of voice, are discussed frequently in this book. Such cues are mentioned in the context of communicating effectively with dogs, and in specific training situations (Tables 2.5, 2.6, and 2.7). For example: "Make eye contact and give a quick shake as you scold" (Monks of New Skete, 2002, p. 72). And: "Call the puppy in a light, happy tone of voice, and when the puppy comes to you, praise her exuberantly ... You should be on your knees when you call the pup. Your arms should be open wide, to help "funnel" the pup toward you" (Monks of New Skete, 2002, p. 196).

Detailed, replicable instructions on how to teach basic commands are given, accompanied by illustrative photographs. Some of the methods recommended in this book include physical manipulation of dogs into the sit or down positions (e.g., putting pressure on a dog's back during 'down' training), with the application of positive reinforcement or punishment, depending on the success of the exercise (Tables 2.6 and 2.7). The authors recommend using particular physical cues when teaching a dog to come (Table 2.7).

Discussion

General Content

The books examined in this study differed in their overall focus and content. This study compared the information contained in books found as a result of an online search for "dog training" books. A limitation of this research was that the key words may not necessarily reflect the authors' intention for how the books should be used. For instance, neither Millan and Peltier (2006) nor Pryor (1999) claimed that their books were dog training manuals by definition. Millan's and Peltier's (2006) book was aimed at teaching owners how to understand and communicate with their dogs using Millan's concept of 'energy', as well as how to modify undesirable behaviour through his 'correction' (positive punishment) techniques. Bearing this in mind, this book's usefulness as a general dog training text is, understandably, questionable. The aim of Pryor's (1999) book appeared to be explaining learning principles and their practical application to any species rather than being a dog training manual per se, and as such a lack of dog-specific advice or examples was to be expected. Nonetheless, these books were examined because they were listed as best-selling books found using the key words "dog training", and thus purchasers of these books may have anticipated dog-specific, training advice.

Puppy training books were excluded from this study because it is possible that much of the information they contain is relevant to dogs' early life stages and thus only puppy owners might read those books, as compared to a general dog training text that may be referred to by a larger section of the dog owning community. However, it would be interesting to repeat this study including puppy training books and to compare those results.

Fennell's (2002) book expounded her theory on pack hierarchy and 'leadership', and it contained many examples of the application of this theory seemingly changing dogs' behaviour. The constant reference to leadership theory could cause owners to overlook basic learned causes of behaviour problems; and the frequent anthropomorphisms may be problematic in helping dog owners objectively assess their dogs' behaviour. Indeed, unsubstantiated or incorrect assumptions are often made about dogs' emotional capacity (e.g., dogs looking 'guilty', Horowitz, 2009), and this can contribute to behaviour problems (Bradshaw & Casey, 2007).

Stilwell (2005) and the Monks of New Skete (2002) took a more holistic approach to their books, including information on topics from dog food to dog deaths. Both books emphasised human-dog communication, and provided detailed training instructions that could be applied readily by owners. Their overall training methods, however, were in stark contrast to each other: Stilwell (2005) emphasised positive reinforcement with the use of minor punishers (e.g., "ah ah ... a harsh, guttural sound"; p. 75), and luring techniques for training basic tasks; whereas the Monks of New Skete (2002) readily recommended positive punishment, some arguably harsh (e.g., "How hard do you hit the dog? A good general rule is that if you did not get a response, a yelp or other sign, after the first hit, it wasn't hard enough"; p. 75), and physical manipulation during training.

Learning Theory

Terminology. Some authors demonstrated a preference for non-behavioural terminology, and instead assigned their own labels to the concepts. Millan & Peltier (2006), Stilwell (2005), and the Monks of New Skete (2002) used the word 'correction' to mean any form of punishment. Stilwell states that "a

correction is not a punishment" (Stilwell, 2005, p. 75). Although the corrections this author refers to (verbal reprimands and 'time outs') may be formally classed as punishers when they reduce the problem behaviour (e.g., Catania, 1998), they do not cause physical pain to the dog. Training using these techniques and not advocating the use of electric shock and pain is often termed as 'positive'. The term 'reward' was used by all authors with the exception of Pryor (1999).

Dog owners don't necessarily need to know the scientific terminology for behavioural terms in order to train their dogs successfully. However, terms such as 'positive reinforcement' have become popularised, particularly with the advent of dog training television series (such as those featuring some of these authors). Inconsistencies surrounding both the use and meaning of such behavioural terms could lead to confusion.

Explanations of learning theory. There were inconsistencies between the explanations of learning theory across books. Some authors defined these concepts in the same manner as they are operationally defined in academic literature, whereas the explanations in other books were cursory.

Pryor's (1999) book provided the most comprehensive explanation of learning principles, focusing extensively on the theory and applications of reinforcement. Millan & Peltier (2006), Fennell (2002), and Stilwell (2005) all omitted explanations of either reinforcement or punishment (or both, in the case of Fennell's book), despite citing examples of both training methods throughout their texts. Whilst the Monks of New Skete (2002) state that the lowest level of positive punishment that obtains the desired effect should be used, their advice on progressively increasing the intensity of the punishment contrasts with that given in scientific literature. Experimental evidence has shown that when positive

punishment is introduced at mild levels and gradually increased, animals can habituate to the punishment and continue responding despite what eventually become relatively high levels of punishment; whereas if those same high levels of punishment are introduced from the onset, the behaviour often ceases (Mazur, 2001; Schwartz, Wasserman, & Robbins, 2002). Thus from a perspective of efficaciousness and animal welfare it could be said that if positive punishment is to be used, it should be introduced at a high intensity from the onset as this will be most effective and require fewer punishments. Many dog owners are not familiar with learning theory, and accurate descriptions are likely to provide a greater understanding of them. This in turn, may allow owners to make better-informed decisions about when to apply these methods.

When to deliver reinforcement and/or punishment was covered by all authors, but the advice was not consistent. Stilwell (2005) and Pryor (1999) gave precise, replicable instructions regarding timing of positive reinforcement: within one second of the desired behaviour, and in conjunction with the desired behaviour, respectively. Millan & Peltier (2006) gave clear directives on when to deliver positive punishment, stating it should be given the instant an undesirable behaviour occurs. Fennell (2002) discussed timing on occasion, and in one example, advocated issuing the command after the emitted behaviour – this could make it more difficult to get dogs to respond to commands. Some of the Monks of New Skete's (2002) directions on consequence delivery featured immediacy. Academic literature generally places importance on a close temporal relationship between the target behaviour and reinforcement or punishment. Reinforcement and/or punishment is considered most effective when delivered immediately after an emitted behaviour (Bouton, 2007). The degree of correlation between a

behaviour and its effects (the reinforcer) is important during learning (Baum, 1973); that is, the occurrence of a behaviour during training has to be predictive of the reinforcer. While temporal contiguity alone is not sufficient for learning, the shorter the delay between the behaviour and its effects the higher the correlation between these two events should be (Baum, 1973). Although animals can learn novel tasks when positive reinforcement is delayed, such delays can decrease the correlation between the behaviour and the reinforcer (e.g., by giving time for other behaviours to occur before the reinforcers are delivered), and so can also result in compromised speed of task acquisition and slower rates of responding (Dickinson et al., 1992; Lattal & Gleeson, 1990; Schlinger & Blakely, 1994). The importance of timing was particularly emphasised in two books (Stilwell (2005) and Pryor (1999)) in this review.

Training techniques and applicability. There was variability in the training techniques recommended across these books. Pryor (1999) was a proponent of positive reinforcement techniques. Fennell's (2002) and Stilwell's (2005) books described techniques that were technically positive reinforcement and positive and negative punishment, albeit strongly biased towards positive reinforcement. The Monks of New Skete (2002) also advocated a mixture of positive reinforcement and positive and negative punishment, although their positive punishments were more severe. Millan's & Peltier's (2006) methods predominantly employed positive punishment for behaviour modification.

When evaluating the techniques described when training a dog to either 'sit', 'down', or 'come', only Fennell's (2002), Stilwell's (2005), and the Monks of New Skete's (2002) books can be compared. (Millan & Peltier (2006) and Pryor (1999) did not provide detailed instructions on how to train these tasks.)

The Monks of New Skete (2002) advocated using negative reinforcement (physical manipulation) when training a dog to sit or lie down; this is surprising, as since the 1980s there has been a shift away from physically coercing dogs during training. Despite this, their techniques were explained in detail, accompanied by photographs, and would be easily replicable. On the other hand, not all of Fennell's (2002) non-coercive, luring methods were described in enough detail to replicate easily. Stilwell (2005) also advocated non-coercive training techniques, but explained them clearly, step-by-step.

It is important that dog owners understand how and when to apply particular training techniques. There is often variation in people's ability to identify dog behaviour, including aggression (Diesel, Brodbelt, & Pfeiffer, 2008; Tami & Gallagher, 2009), which may lead to application of training methods inconsistently or at inappropriate times. Many owners who report using physically aversive training techniques (e.g., hitting or kicking, grabbing jowls, or doing an 'alpha roll'), state that their dogs responded aggressively to such interventions (Herron et al., 2009). Owner-reported behaviour problems often include types of aggression, so the inappropriate use of physically aversive training techniques may pose a danger to the owner. Although it is important to note that the choice of training methods employed by a person may be a reflection of the behaviour displayed by the dog (for example, there may be a stronger tendency for people to punish dogs who are displaying problem behaviours), studies have found an association between the reported use of only positive reinforcement and few behaviour problems, and vice versa (Blackwell, et al., 2008; Hiby, et al., 2004). Reward-based training methods have also been associated with dogs' ability to learn a novel task, whereas punishment-based training methods were negatively

correlated with performance at a novel task and dogs' levels of social interaction with an unfamiliar person (Rooney & Cowan, 2011). In addition to this, dogs can display behavioural signs of stress (e.g., lowered posture) and physiological responses (e.g., increased cortisol values) in response to aversive stimuli (Beerda, Schilder, van Hooff, de Vries, & Mol, 1998; Haverbeke, Laporte, Depiereux, Giffroy, & Diederich, 2008). Although a causal link has not been established, it could be argued that punishment-based techniques have been shown to be associated with fewer benefits than reward-based training methods and in actual fact, have been associated with significant negative effects (e.g., aggressive responses). Considering all of this, advising the general dog owning public to use physically aversive training techniques, as suggested in some of these books, may not be the most prudent course of action in terms of safety and animal welfare.

Human-given Cues

Most of the books referred to the use of human-given communicative cues in general terms (e.g., when greeting dogs, on walks, modifying undesired behaviours, etc.), with the exception of Pryor's (1999) book which contained very little of this. More-noticeable differences between books became apparent when comparing the information provided with regards to teaching the specific obedience tasks: 'sit', 'down', and 'come'.

Millan & Peltier (2006) did not provide any instructions on how to teach these tasks. Pryor (1999) mentioned using certain human-given cues when teaching 'sit' and 'come', but without details. Fennell (2002) gave instructions on proximity and using hand gestures during training 'sit', and several cues for teaching come. Her description of training 'down' contained scant detail, making it difficult for readers to replicate easily. Stilwell's (2005) and the Monks of New

Skete's (2002) books provided the most detailed advice with regards to which human-given cues owners should use when training the 'sit', 'down', and 'come' commands. Both of these books detailed the use of a range of human-given cues while training these tasks, although the Monks of New Skete (2002) discussed more cues than Stilwell (2005) and also provided photographs illustrating the training methods.

Academic literature has shown dogs to be receptive to human-given cues such as vocalisations, pointing, and glancing (e.g., Fukuzawa et al., 2005a; Miklósi et al., 1998). Because dogs are sensitive to human cues, and thus they may have an effect during training, dog owners could get benefit from using such cues more judiciously. Although all of the books (with the exception of Pryor, 1999) did refer to human-given cues throughout, when it came to explaining how to teach three common obedience tasks the level of detail in the instructions was variable across the books.

General Discussion

This chapter described two studies: a scoping study of interviews with dog owners and dog trainers, aiming to assess the importance they place upon different sources of dog training information as well as the use of various human-given cues; and an evaluation of popular dog training literature with regards to the information they contained on principles of learning and human communicative signals.

Interviews of dog owners and trainers showed that participants' personal experiences were given more weight than any other potential source of dog training information, closely followed by books. High importance was also placed

on other informal, free sources such as discussions with other owners and trainers, and the Internet. The human-given cues considered the most valuable during training were 'tone of voice', 'eye contact', and 'hand gestures'; research shows dogs are responsive to such cues. However, a number of disparities were seen between participants' low rankings of other cues and scientific evidence for the importance of such cues. Overall, these interviews suggest that participants' opinions on dog training and human-given cues are based on a mixture of individual experiences and lay information, as well as scientifically-supported information.

Good dog training books should have information that readers can understand and apply, as well as a scientific basis to their theories. The review of five popular 'dog training' books found that these texts do not all meet these functions, and thus are not necessarily instructional manuals for dog owners. This study revealed inconsistencies in the information provided with regards to learning theory and the use of human-given cues during training. Clear, replicable information was not presented in all books, and some failed to give precise instructions (e.g., Fennell, 2002). Training methods differed across the books, with some authors (i.e., Millan & Peltier, 2006; Monks of New Skete, 2002) advocating positive punishments that may be inadvisable for people to use. While Pryor's (1999) book contained in-depth discussions on aspects of learning theory, the fact that it is a general training text (and thus lacks many dog-specific instructions) may mean it doesn't fulfil all purchasers' needs if they are seeking a "dog training" book. Of all the books examined in this study, Stilwell's (2005) book *It's me or the dog* reflects a relatively current understanding of dog behaviour and training techniques, combined with providing the most easily-

applied information and recommending methods generally accepted to be safest and easiest for dog owners to replicate. These books have consistently remained high on the best selling lists of three large Internet retailers over the past five years; this indicates the books' on-going popularity and that they probably contribute significantly to the type of information that is accessed by dog owners.

In summary, it is important for people interacting with dogs to have access to accurate information on dog training, for reasons of efficacy and animal welfare. These two studies have demonstrated that whilst dog training information is sourced from a variety of places, the quality of it cannot always be relied upon.

Positive reinforcement is advocated commonly in modern dog training. Timing of human-given feedback, including positive reinforcement, during dog training was emphasised in some of the books reviewed in this study. It has been shown that delays in the delivery of positive reinforcement can affect how well some other species (e.g., rats and pigeons) learn novels tasks (Chapter 1). The next study in this thesis will examine everyday dog training to see what takes place, with a particular focus on the timing of positive reinforcement delivery.

CHAPTER 3: OBSERVATIONS AT DOG TRAINING CLUBS

Introduction

The interview participants in Chapter 2 identified human communicative cues (e.g., hand movements) that they perceived as being important during dog training, and dogs' responsiveness to many of these cues has been demonstrated in empirical research (e.g., Miklósi et al., 1998; see Chapter 1). On this basis it is reasonable to suggest that dogs may also be sensitive to human-given cues that are delivered after dogs have performed responses during training. Such human-given cues could include forms of positive reinforcement such as verbal and physical feedback (e.g., "good dog" or patting), or the delivery of food treats.

The timing of human-given feedback (i.e., positive reinforcement) during dog training was discussed in some of the books reviewed in Chapter 2, with individual authors placing differing emphasis on the importance of it. The impacts of delayed positive reinforcement on animal learning have been described in Chapter 1; for example, rats showed slower task acquisition and lower response rates when they were exposed to delayed reinforcement (e.g., Byrne et al., 1998). Because delayed reinforcement can affect other animals' learning, any delays in human-given feedback during dog training may affect the training outcomes. There are two known published studies that consider timing of human-given feedback during dog training. Smith and Davis (2008; described in Chapter 1) found no difference in the number of trials dogs required to learn a novel task, between dogs who received food that was delayed approximately 1 s during training and dogs who received an immediate 'click' and then the food. However, the food reinforcement was delivered by hand, so the timing of it was not

precisely controlled. A study by Yamamoto et al. (2009; see Chapter 1) involving well-controlled delays, found that short delays (0.5, 1.0, and 2.0 s) significantly reduced dogs' responses to known commands. However, all human-given feedback (commands and consequences) was delayed – effectively causing a mismatch in the communication between owners and their dogs. Neither of these studies examined the effects of delayed reinforcement in a way that is comparable to the operant research on delayed reinforcement (Chapter 1). Moreover, there is no known research that has investigated if delays are common, or the nature of such delays, in ordinary dog training.

This study examined everyday dog training to see what kinds of human-dog interactions took place, with a particular focus on identifying whether delays were commonplace. Field observations of human-dog training interactions are limited (e.g., Braem & Mills, 2010). Thus, the purpose of this study was to conduct observations of ordinary people training their dogs in real-life situations and to add to the body of knowledge regarding these kinds of training situations.

The aim of these observations was to investigate how and when owners deliver reinforcement, including their use of conditioned and unconditioned reinforcers; and to examine whether delayed reinforcement had any effect on the dogs' behaviour, such as their 'obedience'. It was hypothesised that conditioned reinforcement (in the form of verbal praise) would usually be given to dogs prior to unconditioned reinforcement (food treats), and that reinforcement delivery times would vary across owners. It was also hypothesised that there would be a relationship between longer delays to reinforcement and poorer performances (i.e., fewer correct responses to commands) by the dogs.

Method

Participants

Owners and their dogs were recruited from three dog training clubs in the Waikato region, New Zealand. Volunteers were recruited from the beginners' training classes at each club. Fifteen owners and their dogs took part in this study. The owners were 13 females and two males (Table 3.1). They ranged in age from 22 to 69 years (one age not specified), with a median age of 37 years; and they had varying prior experience with dogs and dog training (Table 3.1). The dogs were six females and nine males (Table 3.2). Most of the dogs were puppies, ranging from 0.25 to 2 years, with a median age of 0.3 years; and they were an assortment of breeds (Table 3.2).

Approval for this research was gained from the University of Waikato School of Psychology Research and Ethics Committee (protocol number 09:38). The University of Waikato Animal Ethics Committee was notified of this research and advised the researcher that no formal application was required. Prior to the study commencing, owners were given an information sheet to read; this outlined the topic and requirements of the study, but did not mention timing of reinforcement specifically. All dog owners were given the opportunity to ask the researcher any questions before they provided written consent.

Study Location and Apparatus

The observations took place at the three dog training clubs from where the dog owners and their dogs were recruited, in the Waikato region, during their normal training classes. The classes were held on week day evenings, once per

Table 3.1

Owners' Demographic and Dog Ownership Information

Owner	Age (years)	Gender	Ethnicity	Number of dogs owned in lifetime	Period of dog ownership in lifetime (years)	Level of obedience training attained (with any dog)
3.1[a]	22	Female	NZ European	1	0.1	N/A
3.2[a]	22	Male	Chinese	1	0.1	N/A
3.3[a]	26	Female	European/Maori	2	0.2	N/A
3.4[a]	60+	Female	NZ European	10	30	Intermediate
3.5[a]	19	Female	South African	1	0.2	N/A
3.6[a]	30	Female	NZ European	1	0.1	N/A
3.7[a]	55	Female	NZ European	4	16	Beginner
3.8[b]	33	Female	Maori	1	0.1	N/A
3.9[b]	63	Male	NZ European	3	35	Beginner
3.10[b]	25	Female	Tongan/European	1	0.3	N/A
3.11[b]	69	Female	NZ European	12	60	Intermediate
3.12[b]	49	Female	European	3	3	Beginner
3.13[c]	62	Female	NZ European	2	11	Beginner
3.14[c]	39	Female	NZ European	1	0.1	Beginner
3.15[c]	37	Female	Spanish	4	6	Advanced/Canine Good Citizen

[a]Dog training club 1, [b]club 2, [c]club 3.

Table 3.2

Details of the Dogs Who Participated in This Study

Dog	Age (years)	Sex	Breed
Bailey[a]	0.25	Female	Cocker spaniel
Tank[a]	0.25	Male	Labrador retriever
Jaz[a]	0.3	Female	Labrador retriever
Buster[a]	2	Male[n]	Chihuahua
Flekkie[a]	0.3	Female	Labrador retriever cross
Chester[a]	0.3	Male	Miniature poodle
Lily[a]	0.75	Female[s]	Fox terrier cross
Tama[b]	0.25	Male	Border terrier cross
Toddy[b]	1	Male	Jack Russell
Bentley[b]	0.5	Male[n]	Pit bull terrier cross
Tarn[b]	0.5	Male	Miniature poodle
Jazz[b]	0.3	Male	Bichon frise
Cocoa[c]	1	Female[s]	Miniature poodle
Bella[c]	1	Female	Border collie x golden retriever
Pluto[c]	0.3	Male	Rottweiler

[a]Dog training club 1, [b]club 2, [c]club 3.

[n]Neutered, [s]spayed.

week, for eight to 10 weeks. Classes contained groups of approximately 10 to 15 people, with one or two instructors per class.

Three Panasonic® camcorders (two NV-GS300, and one AG-AC90), mounted on tripods, were used to film the owner-dog dyads (one camera per dyad). The cameras recorded onto Sony® miniDV digital video cassette tapes of either 60 or 90 minutes duration. Wireless lapel microphones (JWL® WM-300 or AKG® C417) that plugged into the cameras were worn by the owners being filmed.

Clipboards and pens were used to record any verbal instructions given by the dog club instructors to owners (either individually or to the class) that related to timing of reinforcement or human-dog communication.

Design

Three owner-dog dyads were filmed per training evening at each dog club. The owners were filmed participating in their class activities with their dogs as per normal. Owners were not given any instructions on training, including reinforcement, by the researcher.

The video footage was used to count and measure the human-dog interactions that took place during training classes (one class was considered to be one session). These data included the number of commands ('sit' and 'down' only, see *Measures* below) given by owners to the dogs, how dogs responded to those commands, the type and order of positive reinforcement delivered by owners, and the owners' latencies to deliver positive reinforcement. Each command-response-reinforcement sequence was considered to be one independent trial.

Measures. Dogs' responses appropriate for analysing the time delay between responses and delivery of positive reinforcement required clearly-definable finish points, so the commands 'sit' and 'down' were selected. Other commands (e.g., 'stay') given by owners during the sessions were disregarded. If a dog's name preceded the command, the name was disregarded (because owners frequently spoke their dogs' names first, followed by no command). Sometimes numerous commands were given by owners to their dogs. The commands that were given prior to the particular command that actually prompted a dog's response were recorded as the dog not responding (e.g., if an owner said "sit, sit, sit" and the dog began responding on the third command, then the first two commands were counted as non-responses); commands given after the dog had

started responding were disregarded. Trials in which an owner's speech could not be distinguished clearly were removed from analysis.

The dogs' responses to commands were recorded, including instances of dogs responding to commands but not receiving reinforcement, dogs giving incorrect responses, and dogs not responding at all.

A 'sit' response was defined as when a dog moved from a standing position to lower their hindquarters onto the ground with their forelegs remaining vertical and holding their head, chest and shoulders off the ground. A 'down' was defined as when a dog lowered its body to lie on the ground horizontally, from either a standing or sitting position. Trials in which a dog's body was obscured so that their response could not be measured (e.g., they sat down behind their owner's legs with their hindquarters obscured) were discarded from analysis.

The timing of the owners' feedback was measured (see *Video analysis* below). Food treats, patting, and the owners engaging in play with their dogs were considered to function as unconditioned reinforcement. If an owner's physical delivery of reinforcement was not seen clearly (e.g., if they delivered a treat as another person walked in front of the camera), this was not included in analysis. It was assumed that verbal praise or other positive feedback (e.g., "good dog", "yes") had been sufficiently associated with unconditioned reinforcement prior to the dogs coming to the training classes so as to function as conditioned reinforcement.

Video analysis. Preliminary analysis was done on each video prior to the formal analysis, for two reasons. Firstly, limited resources allowed for filming of just three owners per training evening, and the classes ran for eight to 10 weeks only (depending on the club). Given these constraints, the goal was to record a

total of 30 trials (‘sit’ and ‘down’ combined) suitable for timing analysis per owner-dog dyad, before filming of another dyad commenced. Weekly preliminary analysis was done by watching each session (using Windows Media® Player) once, counting potential trials. When it was determined that at least 30 potential trials had been filmed for an owner (which may have spanned more than one session), filming of this owner ceased and commenced with another owner. The second reason for the preliminary analysis was to familiarise the researcher with the behaviour of the owners and their dogs.

Formal video analysis was carried out using Adobe® Premiere® Pro (version 4.0.0) video editing software. This programme was used to watch the videos, count the events, and measure the times between specific events. A timeline, corresponding to the footage, was visible below the videos as they played in this software (Figure 3.1). Time measurements were made by marking locations on this timeline. The video footage could be scrolled through as slowly as 25 frames per second (40 ms resolution) to allow for accurate time measurements. Once made, these measurements would appear on the video footage concurrently (Figure 3.1).

The dogs’ responses were measured from the point at which a dog’s rump first touched the ground for ‘sit’ responses, and from when a dog’s elbows first touched the ground (providing their hindquarters were already lowered to the ground) for ‘down’ responses. If a dog’s elbows were placed on the ground first (which was rare), the ‘down’ was measured from when their hindquarters first touched the ground.

An owner’s latency to reinforce their dog’s behaviour was measured from the dog’s response time to the time when the owner delivered the reinforcement.

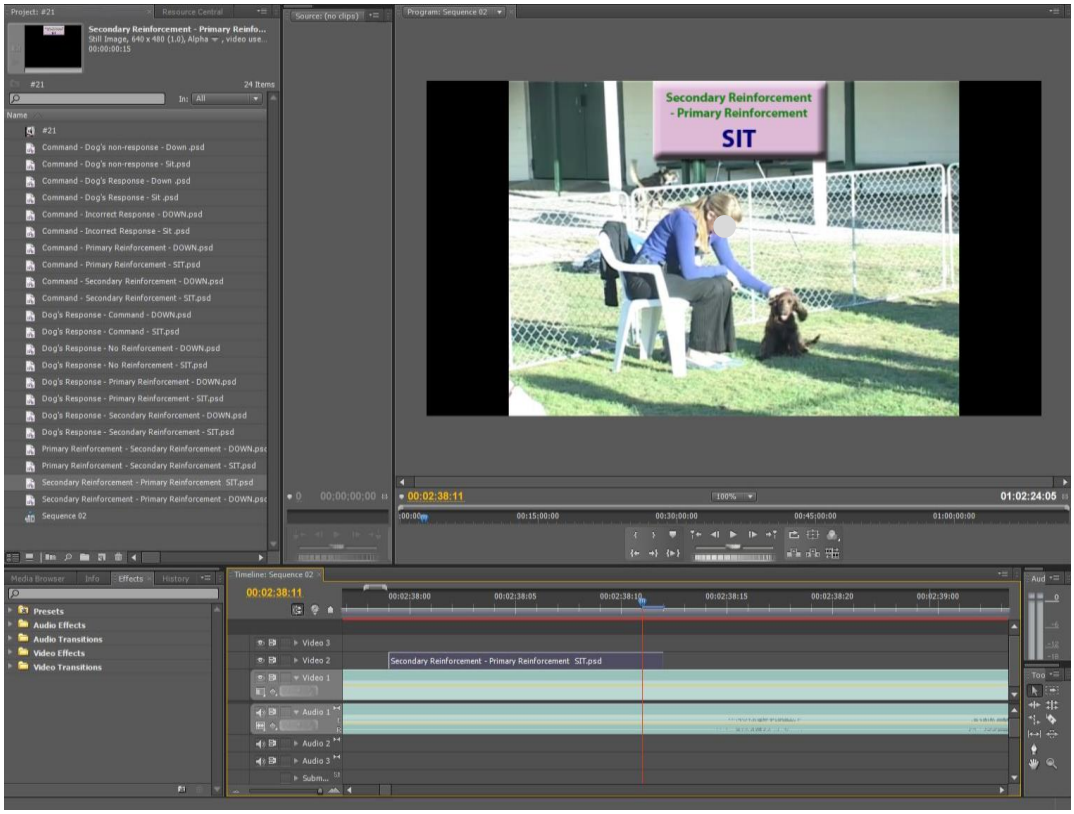

Figure 3.1. A screen shot of a video being analysed for timing of events in Adobe® Premiere® Pro. The timeline is shown in the lower half of this image, on which time measurements were marked. A picture corresponding to the particular event being measured appears on the video, which is shown in the upper half of this image.

If a second instance of reinforcement was also given then that delay was measured from the first instance to the second instance of reinforcement. (Note: these measurements were only able to be made when a dog responded to a command.) Food delivery was measured at the point at which food was placed immediately in front of a dog's mouth. Patting and play were measured at the points where an owner's hand was extended and just about to stroke their dog, and as an owner initiated a play action (e.g., the lead was presented immediately in front of the

dog's mouth for the dog to tug on), respectively. Verbal praise was measured from the start of the first praise word.

For all of these measurements, the footage was scrolled through slowly, frame by frame (at 25 frames per second), until the above-described time points were identified precisely. To pinpoint the start of a verbal praise word, the video was played repeatedly until the start of the word could be narrowed down to only a few frames and eventually the start of the word could be determined. A measurement was made at these points on the timeline. Once all of the time measurements had been completed, each Adobe® Premiere® Pro file was used to extract the timing information and an output of the measured times was generated.

Procedure

Three owner-dog dyads were filmed per training evening at each dog club by the researcher and two assistants. Each owner was filmed for the entirety of their class (one session) which was approximately one hour. Owners were not requested to train their dog in any way other than what was required for normal class participation.

Cameras were placed on the periphery of the classes to avoid interfering with class activities. It was often necessary to zoom in on the owners and their dogs from a distance due to this placement, and thus a period of habituation time for the dogs to adjust to the presence of the cameras and the researcher/assistants was not necessary. Attempts were made to film owners and their dogs in profile view, in order to capture as many behaviours emitted by the owners and their dogs as possible.

Data Analysis

The number and types of commands given by owners, and responses performed by dogs, were summarised using descriptive statistics; as were the data on owners' timing of positive reinforcement delivery.

The data were not normally distributed, so non-parametric tests were used. Wilcoxon signed-rank tests were conducted to compare the latency of owners to positively reinforce dogs' responses to both 'sit' and 'down'. Wilcoxon signed-rank tests were also used to compare the delays to unconditioned and conditioned reinforcement.

Spearman's rank correlations were used to examine the relationships between the total number of commands given, the dogs' responses to those commands (i.e., relative frequencies of correct responses, correct responses with reinforcement received, correct responses without receiving reinforcement, incorrect responses, and no responses), and the owners' average delays to delivery of conditioned and unconditioned reinforcement.

Twenty five percent of trials (including at least one trial from each owner) were randomly selected for reanalysis by an independent observer to test for inter-observer reliability. The independent observer was trained to analyse the trials using the methods described above. A Pearson's correlation was performed on the inter-observer reliability data, and reliability was considered to be good at 85% agreement (as per Smith & Davis, 2007). A total of 106 trials, and the events within them, were reanalysed. Inter-observer reliability was very strong ($r(366) = 1.00$, $p < .001$), showing excellent agreement between the researcher and the independent observer.

SigmaPlot (version 12.5) was used to construct all graphs. IBM® SPSS® Statistics (version 21.0.0.0) software was used to perform all statistical analyses. Statistical significance was accepted at $p < .05$ for all tests.

Results

Owners gave a total of 2,788 'sit' and 'down' commands during this study. Thirty five percent (978/2,788) of these commands had to be discarded for various reasons. Data could not be used in instances such as when microphones failed, cameras were out of focus, and owners or dogs moved out of the camera shot (e.g., when a dog sat behind their owner's legs).

A total of 1,810 commands remained for analysis. Of these commands, 77.51% (1,403/1,810) were 'sit' and 22.49% (407/1,810) were 'down'.

Responses to Commands

Overall, the dogs responded correctly to 52.93% (958/1,810) of commands, regardless of the feedback given by the owners (Table 3.3). The dogs received positive reinforcement for responding correctly to 22.38% (405) of the commands, ranging from 12.57% to 41.51% for individual dogs (Table 3.3). These trials were used for timing analysis (section *Delays to Positive Reinforcement* below). The dogs responded correctly but received no reinforcement of any type for 30.55% (553) of commands; this ranged from 3.70% to 46.30% across individuals (Table 3.3). Dogs responded incorrectly to 2.87% (52) of commands, ranging from 0% to 10.26% (Table 3.3). In addition, 44.20% (800) of commands elicited no response from the dogs, ranging from 26.96% to 62.96% for individual dogs (Table 3.3). A summary of all of the dogs' responses to commands is presented in Figure 3.2.

Table 3.3

Outcomes of Training Interactions When 'Sit' and 'Down' Commands Were Given by Owners During Dog Training Classes

Owner	Correct response, R+ given	Correct response, no R+ given	Incorrect response	No response	Total commands given
3.1	24 (34.78%)	14 (20.29%)	0	31 (44.93%)	69
3.2	22 (41.51%)	8 (15.10%)	2 (3.77%)	21 (39.62%)	53
3.3	25 (22.73%)	49 (44.54%)	0	36 (32.73%)	110
3.4	28 (16.00%)	57 (32.57%)	6 (3.43%)	84 (48.00%)	175
3.5	35 (23.81%)	42 (28.57%)	5 (3.40%)	65 (44.22%)	147
3.6	31 (13.25%)	42 (17.95%)	24 (10.25%)	137 (58.55%)	234
3.7	43 (37.39%)	35 (30.43%)	6 (5.22%)	31 (26.96%)	115
3.8	35 (32.41%)	4 (3.70%)	1 (0.93%)	68 (62.96%)	108
3.9	24 (12.57%)	84 (43.98%)	4 (2.09%)	79 (41.36%)	191
3.10	28 (25.92%)	50 (46.30%)	0	30 (27.78%)	108
3.11	14 (18.92%)	32 (43.24%)	0	28 (37.84%)	74
3.12	17 (36.96%)	15 (32.61%)	0	14 (30.43%)	46
3.13	33 (23.91%)	45 (32.61%)	0	60 (43.48%)	138
3.14	25 (16.89%)	52 (35.13%)	3 (2.03%)	68 (45.95%)	148
3.15	21 (22.34%)	24 (25.53%)	1 (1.06%)	48 (51.07%)	94
Total	405 (22.38%)	553 (30.55%)	52 (2.87%)	800 (44.20%)	1,810

Note. Response = the dogs' responses to the commands; R+ = positive reinforcement.

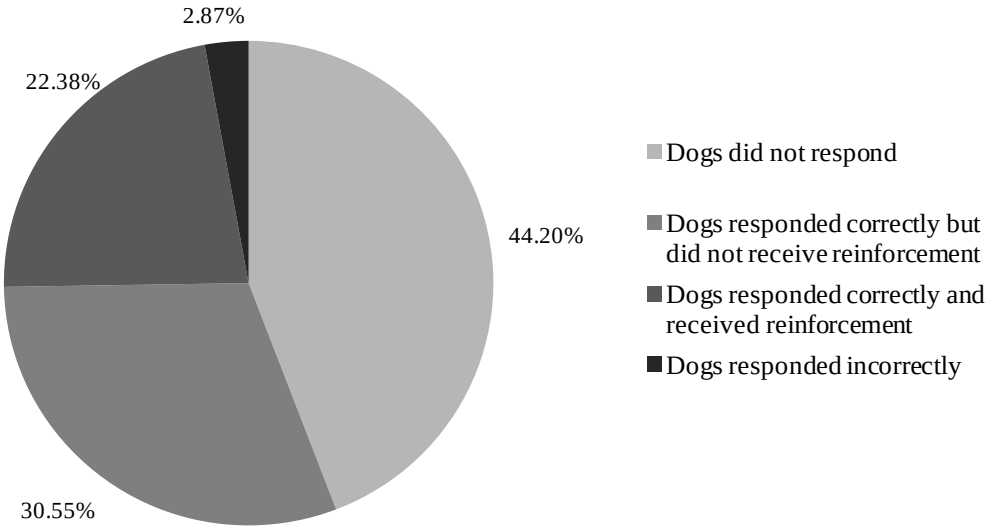

Figure 3.2. Outcomes of the 1,810 'sit' and 'down' commands given by all owners.

Reinforcement Delivery

The most common pattern of owner behaviour was for them to provide two instances of reinforcement to their dog. A second instance of reinforcement was given in an average of 60.74% of trials, ranging from 20.83 to 87.10% for individual owners (Table 3.4).

Conditioned reinforcement was delivered first in the majority (80.00% on average) of trials, whereas unconditioned reinforcement was only given in the first instance in 20.00% of trials on average (Table 3.4). The second instance of reinforcement was most-frequently (83.33% on average) unconditioned reinforcement (Table 3.4). Food treats were used as the unconditioned reinforcers except on four occasions: 'patting' was used three times and play was used once.

Whilst this pattern of reinforcement delivery was the most common, four owners deviated from this appreciably. Owners 3.3, 3.9, and 3.11 tended to deliver either unconditioned or conditioned reinforcement somewhat evenly in both the first and second instances (Table 3.4). Owner 3.10 delivered positive reinforcement in the reverse order, delivering unconditioned reinforcement most-frequently (75.00%) in the first instance and conditioned reinforcement most-often (68.75%) in the second instance (Table 3.4). Across all owners there were seven trials in which reinforcement was delivered at the same time as dogs responded to commands, and both unconditioned and conditioned reinforcement were delivered at the same time on four occasions.

Because the first instance of positive reinforcement was principally conditioned reinforcement (verbal praise), and the second instance was normally unconditioned reinforcement (food; Table 3.4), the data will be presented in terms of conditioned and unconditioned reinforcement (rather than also presenting the

Table 3.4

The Order in Which Owners Delivered Positive Reinforcement to Their Dogs After Correct Responses (Trials)

Owner	Total trials (N)	Trials with a second instance of reinforcement		First instance of reinforcement		Second instance of reinforcement	
		N	%	Conditioned (%)	Unconditioned (%)	Conditioned (%)	Unconditioned (%)
3.1	24	15	62.50	95.83	4.17	6.67	93.33
3.2	22	12	54.55	90.91	9.09	16.67	83.33
3.3	25	17	68.00	56.00	44.00	58.82	41.18
3.4	28	12	42.86	82.14	17.86	0.00	100.00
3.5	35	30	85.71	80.00	20.00	13.33	86.67
3.6	31	27	87.10	96.77	3.23	3.70	96.30
3.7	43	32	74.42	88.37	11.63	12.50	87.50
3.8	35	26	74.29	85.71	14.29	0.00	100.00
3.9	24	5	20.83	54.17	45.83	40.00	60.00
3.10	28	16	57.14	25.00	75.00	68.75	31.25
3.11	14	5	35.71	57.14	42.86	40.00	60.00
3.12	17	11	64.71	100.00	0.00	0.00	100.00
3.13	33	18	54.55	84.85	15.15	22.22	77.78
3.14	25	12	48.00	100.00	0.00	0.00	100.00
3.15	21	8	38.10	95.24	4.76	0.00	100.00
Average			60.74	80.00	20.00	16.67	83.33

Note. Conditioned reinforcement was verbal praise; unconditioned reinforcement included food, patting, and engaging the dogs in play.

first and second instances of reinforcement) for the remainder of the results section.

Delays to Positive Reinforcement

Owners took an average of 0.60 s to reinforce correct responses to the 'sit' command; and an average of 0.73 s to reinforce dogs' responses to 'down' commands. There were no statistically significant differences between the average times owners took to deliver conditioned reinforcement for 'sit' and 'down' commands (z = -1.099, p = .272), or unconditioned reinforcement for 'sit' and 'down' commands (z = -1.083, p =.279). Given these results, the dogs' responses to both commands were pooled for all further analyses.

The average time taken for owners to deliver all positive reinforcement (conditioned and unconditioned) across all trials (N = 405) was 1.17 s. There was variation in the delays to reinforcement, both within, and across, all owners (Figure 3.3). Individual owners' average times to deliver all reinforcement ranged from 0.44 to 2.22 s.

When examined separately, there were differences in the average delays to conditioned and unconditioned reinforcement delivery. Conditioned reinforcement was delivered by all owners with an average delay of 0.62 s; and individual owners' average delay times ranged from 0.28 to 1.67 s (Figure 3.4). The average delay of all participants to deliver unconditioned reinforcement was 0.98 s; individual owners' average delays ranged from 0.12 to 2.34 s (Figure 3.4). There was a marginally significant difference between owners' latencies to deliver conditioned reinforcement or unconditioned reinforcement (z = 1.70, p = .088).

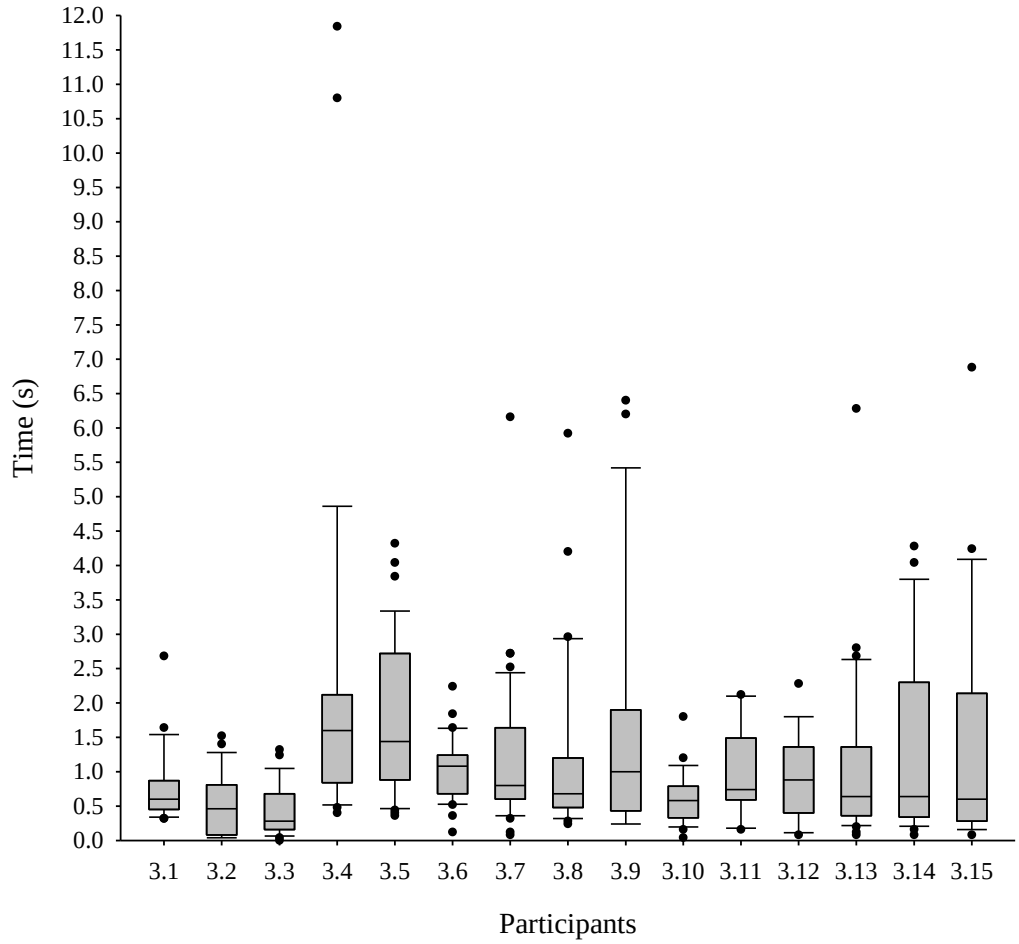

Figure 3.3. The total times taken for owners to deliver all instances of positive reinforcement (conditioned and unconditioned) to their dogs for all responses ('sit' and 'down'). Boxes represent 25th, 50th and 75th quartiles; whiskers represent 10th and 90th percentiles. Outliers are indicated by dots.

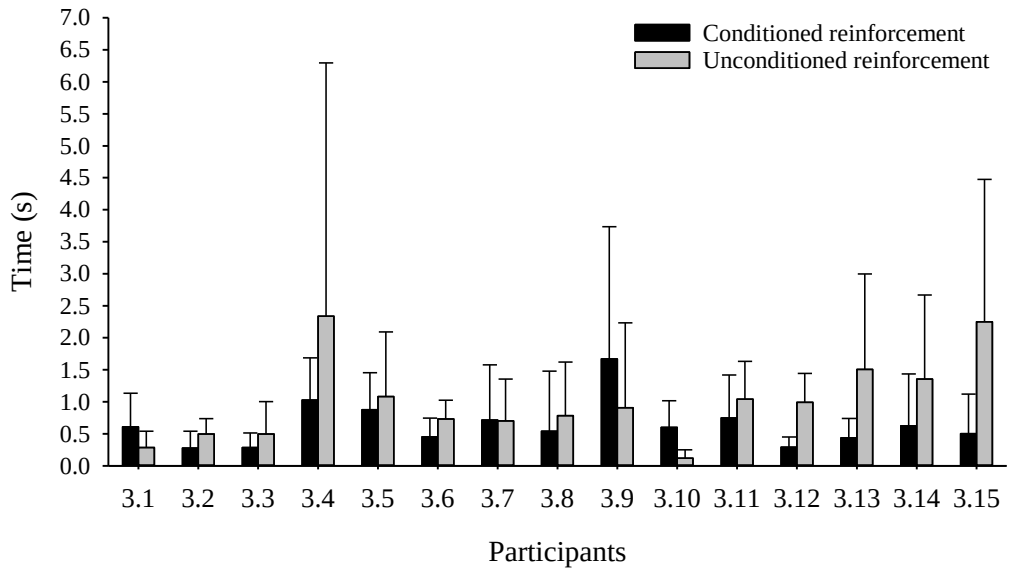

Figure 3.4. Owners' average delays to deliver conditioned reinforcement (e.g., verbal praise; normally following the dogs' responses), and their average delays to deliver unconditioned reinforcement (e.g., food; normally following conditioned reinforcement delivery). These data are for all responses ('sit' and 'down'). Bars represent the standard deviations.

Relationships Between Responses to Commands, Responses, and Delays to Reinforcement

As the relative frequency of dogs' incorrect responses increased, so too did their non-responding to commands ($r(15) = .643$, $p = .010$).

Average delays to conditioned reinforcement increased with a larger percentages of commands obeyed by the dogs ($r(15) = .612$, $p = .015$). There was a marginally significant relationship between the average delays to conditioned reinforcement and the total number of commands given by owners ($r(15) = .474$, $p = .075$), and the relative frequencies of dogs' responses that were not reinforced ($r(15) = .461$, $p = .084$). No other meaningful correlations were found.

Discussion

This field study aimed to investigate the types of interactions that took place during naturalistic dog training, including how and when positive reinforcement was delivered to dogs by their owners. The results of this research show that these dogs had a poor rate of responding to owners' commands; that there was a clear and consistent pattern of positive reinforcement delivery; and that there was variation in owners' delays to deliver positive reinforcement to their dogs.

The dogs in this study responded correctly to only 52.93% (958/1,810) of the commands their owners issued. The dogs also failed to respond at all to 44.20% (800/1,810) of their owners' commands. Other research has reported higher rates of compliance. For example, a field study by Braem and Mills (2010) found that 68% of the dogs that they observed obeyed their first 'sit' command; although those dogs were already familiar with that command. In a survey by Kobelt et al. (2003), 75% of dog owners claimed that their dogs obeyed commands 'always' or 'often'; however, the average age of those dogs was 6.8 years. The owners and dogs in the current study were recruited from beginner dog training classes and so the dogs' prior learning was likely to be relatively limited, and all but one of the dogs were one year old or less; these factors could account for such a low rate of compliance. Regardless of the reasons behind this low response rate, this finding is an important one because it indicates that there is scope for improvement in the efficacy of everyday dog training. Given the link between obedience training and a lower occurrence of behaviour problems in dogs (e.g., Kobelt et al., 2003), and the association between unwanted dog behaviours and increased risk of dogs being relinquished to animal shelters (e.g., Diesel et al.,

2010), successful dog training is important for both the enjoyment of owners and the welfare of dogs (see Chapter 1 for a discussion).

The overall average delay to all positive reinforcement (conditioned and unconditioned) being delivered to the dogs was 1.17 s, with considerable variation observed across individual owners. The average time taken by the owners to provide conditioned reinforcement after the dogs' responses was 0.62 s; this average delay is reasonably short, and this was normally the first instance of reinforcement that the dogs received. However, there was a range of delays to conditioned reinforcement observed in this study also. Given the importance placed on temporal contiguity during learning and that reinforcement is considered to be the most effective when it's delivered immediately after an animal performs a behaviour (Bouton, 2007), the range of delays observed here means that it is likely that the dogs' task acquisition was suboptimal on at least some occasions. In addition to this, some of the delays observed in this study were long enough to allow room for unintentional or ill-timed feedback to occur. For example, one owner was casually observed persistently reinforcing their dog for a response that was inconsistent with the command they had issued. This reinforcement of a non-target behaviour took place due to the dog changing body position (from a sitting to lying down position) during a delay to reinforcement. Yamamoto et al. (2009) also stated that the dogs in their delay study were reinforced for incorrect responses due to the delays imposed. The authors suggested this could have been confusing for the dogs, and a contributing factor to their dogs' reduced performances. The unintentional reinforcement of non-target behaviours is highly likely to lead to reduced training efficacy. Visual inspection

of participants' graphed data revealed no change in delays to reinforcement delivery over time.

Conditioned reinforcement (i.e., verbal praise) was usually the first mode of feedback given by owners following a dog's response to a command. This may be unsurprising given that delivering unconditioned reinforcement (e.g., food) involves a motor movement and therefore takes more time to be received by a dog than verbal praise (Skinner, 1951). It has been shown that verbal praise is unlikely to function as an unconditioned reinforcer for dogs. Dogs' response latencies are greater during training with verbal praise alone as compared to verbal praise paired with patting (McIntire & Colley, 1967); and dogs display a clear preference for patting from a person over verbal praise (Feuerbacher & Wynne, 2015; see Chapter 1). However, the verbal feedback provided by the dog owners in this study was paired frequently with unconditioned reinforcement; thus it is likely that it did function as conditioned reinforcement during this training (although determining the true reinforcing effect of all presumed conditioned reinforcement was outside the scope of this observational study). Overt, measurable signals (e.g., verbal praise) were categorised as conditioned reinforcement in this study; however, it is possible that the dogs were also attending to other subtle owner-given cues that were not measured.

The results indicated that dogs who are more likely to disobey their owners' commands (i.e., not respond) may also be more likely to respond incorrectly. However, only a very small proportion of the dogs' responses were incorrect (2.87%), so this finding must be interpreted with caution. As the relative frequencies of commands obeyed by dogs increased, so too did the average delays to conditioned reinforcement delivery, suggesting that delayed conditioned

reinforcement may be related to increased obedience. This finding was unexpected; however, if dogs responded to more commands this may simply have provided dog owners with more opportunity to delivery delayed reinforcement. Another explanation could be that efforts are often made to reinforce inexperienced dogs as soon as they respond to commands, whereas more experienced dogs are often expected to remain in position for longer; this may affect owners' delays to reinforcement. It would be interesting to compare owners (with a range of training experience themselves) of inexperienced and experienced dogs to see if there is a difference in their delays to reinforcement. The lack of any other significant relationships between delayed reinforcement and the types of dogs' responding suggests that delayed reinforcement may not be the most important, or the only, influence on dogs' responses to commands in such training situations. Alternatively, another variable (e.g., owners' body movements) may be bridging the delay gap (Martin & Friedman, 2011; Smith & Davis, 2008; Williams et al., 2004), thus allowing learning to take place. In addition, this was not a controlled experiment so there were potentially other variables masking the results.

It is worth mentioning that this sample of owners was not randomly selected: the owners paid money to attend formal dog training classes, they were supervised and coached by dog trainers, and they volunteered to be filmed whilst training their dogs. Arguably these dog owners' training skills could be superior to those held by owners in the general population. This leads to speculation on what may be observed when other owners interact with their dogs – it is possible that a wider variation in the delay to reinforcement could be seen.

The large proportion of commands to which dogs did not respond indicates that everyday dog training in these circumstances is not as efficacious as may be desired. This research has established that delays to reinforcement of varying lengths are common in everyday dog training. Experimental research has found that other animal species' learning is affected when positive reinforcement is delayed (e.g., Byrne et al., 1998). However, it is unknown whether delays of lengths similar to those observed in the current study have a similar impact on dogs' learning, when the delays are presented in a well-controlled manner. The next study in this thesis examined delayed reinforcement systematically under experimental conditions, to assess how it affected dogs' learning.

CHAPTER 4: EXPERIMENTALLY DELAYED REINFORCEMENT

Introduction

The delayed delivery of positive reinforcement during everyday dog training is a common occurrence (Chapter 3). As outlined in Chapter 1, rats and pigeons can learn to press levers and peck keys in operant chambers with delays of up to 32 and 30 s, respectively (Dickinson et al., 1992; Lattal & Gleeson, 1990). Studies such as these demonstrate that some animals can learn new tasks in experimental conditions with (sometimes lengthy) delays to reinforcement. However, despite learning taking place at times, such delays can negatively affect the animals' task acquisition times and rates of responding (e.g., Byrne et al., 1998). This suggests that close temporal contiguity between an animal performing a behaviour and it receiving positive reinforcement is important in learning, so employing delayed reinforcement is not the most efficient method of training animals to perform new responses.

Delayed positive reinforcement procedures can be implemented in several ways. Delays can be signalled (a stimulus change, e.g., a light turning off, after an animal's response), or unsignalled. Signals can function as conditioned reinforcers (Lattal, 2010). Rats exposed to signalled (e.g., with a tone issued immediately after a response) delays learn faster and have higher response rates than rats under the same conditions albeit without the signal (Critchfield & Lattal, 1993; Schlinger & Blakely, 1994). For this reason, unsignalled delays remove this confound (i.e., the effect of conditioned reinforcement) on the effect of the delay (Lattal & Gleeson, 1990). Delays can also be resetting or non-resetting. Resetting delays ensure that reinforcement is not delivered until the entire delay period has

elapsed by re-starting the delay time if an animal responds during that period (i.e., they are differential reinforcement of other (DRO) behaviour schedules). Responding during resetting delays can lead to reduced rates of reinforcement and thus reduced response rates (see Lattal, 2010, for a discussion). Alternatively, non-resetting procedures allow animals to continue to respond during the delay period, and therefore actual obtained delays can be shorter than the designated delays. Avoiding the animals performing any responses during delay periods would alleviate this issue; short delays reduce the opportunity for some types of responses to occur.

Whilst the existing literature on the effects of experimentally delayed positive reinforcement with other species is informative and leads to speculation that delays may similarly affect learning in dogs, the impacts of delayed reinforcement on the efficacy of dog training remain to be investigated. The only known published research on delayed reinforcement with dogs was performed by Yamamoto et al. (2009; described in Chapter 1). However, that study involved delaying both commands and consequences, effectively causing a mismatch in the owners' and dogs' behaviours. In addition, Smith and Davis (2008; see Chapter 1) used conditioned reinforcement (clickers) to train dogs, and described their results in terms of the immediately-delivered clicks not altering the training outcome in the face of a short (~1 s) delay to unconditioned reinforcement (food). However, given that precise control over the timing of reinforcement delivery cannot be guaranteed due to their hand-delivery of all reinforcement, the relevance of this result to the examination of the impact of delayed reinforcement during dog training is equivocal (although it is acknowledged that inexact timing is to be expected in naturalistic settings). Although delays to rewards have been used with

dogs in delay to gratification tasks and assessment of impulsivity (e.g., Leonardi, Vick, & Dufour, 2012; Wright, Mills, & Pollux, 2012), there is currently no known published research that has investigated experimentally the impacts of delayed reinforcement (only) on dogs' ability to learn a novel task. Because delays do occur commonly (e.g., Chapter 3), and the experimental literature on other species indicates that delayed reinforcement can impact on animals' learning, the effects of such delays on dogs' learning will be investigated in this chapter.

This study will experimentally manipulate delays to positive reinforcement when dogs are presented with a novel task, with the aim of evaluating the effect of delayed reinforcement on dogs' learning. The hypotheses are that delayed reinforcement will have a negative impact on dogs' abilities to learn a novel task, and that signalled delays will produce results not noticeably different from immediate reinforcement.

Method

Pilot Study: Methodology Development

A pilot study was run to develop the methodology used in the main study (Appendix B). The goal was to design a procedure in which no shaping or human-facilitated luring was required to get the dogs to perform a task that was novel to all subjects. This was so that the delivery of positive reinforcement could be timed precisely with no other feedback being given to the dogs. A typical luring procedure would necessarily involve human communicative cues (e.g., body language) which may have provided feedback to the dogs during training, and ensuring a shaping procedure had standardised successive approximations across

all dogs was not possible in the given circumstances. These factors may have impacted on the results, and thus the goal was to avoid shaping or traditional luring.

A species-typical response for dogs is to investigate environments via olfactory means. The pilot study procedures aimed to take advantage of this by eliciting natural exploratory behaviour that could be captured with positive reinforcement without the target response needing to be shaped or otherwise trained. This pilot study consisted of five procedures, all of which involved the dogs receiving positive reinforcement for performing particular tasks. In Procedures 1 and 2 the dogs were reinforced for moving into a particular area of a large room (different in each procedure). Procedures 3 and 4 involved the dogs receiving reinforcement for investigating one of two boxes (a different type of box in each procedure) in a smaller room. Procedure 5, which was adopted as the procedure for the main study, required dogs to break infrared beams projected across the top of one of two food-scented boxes within a pen much smaller than the previous experimental room. Full details of these procedures are provided in Appendix B.

Main Study

Subjects. Dogs were recruited by word of mouth and advertising at the University of Waikato, dog obedience and agility clubs, local veterinary clinics, dog day care businesses, other work places, and pet shops. One hundred and eleven dogs were initially recruited for this study. Fifty one dogs were withdrawn from the experiment for a variety of reasons, explained in the section *Inclusion criteria* below. The final number of dogs that participated was 60. There were 42 females and 18 males; ranging in age from five months to 12 years, with a median age of 3.25 years; and they were a mixture of breeds (Table 4.1).

Table 4.1

Details of the Dogs Who Participated in the Full Study

Dog	Age (years)	Sex	Breed	Condition[a]
Charles	0.6	Male	Staffordshire bull terrier	1
Sasha	2.5	Female[s]	Huntaway x Rottweiler	1
Niia	4.5	Female[s]	German shepherd	1
Flint	1.5	Male	Heading dog	1
Mishka	8.5	Female	Norwegian elk hound	1
Romsey	6	Male	Gordon setter	1
Rippley	0.75	Female[s]	Border collie x Polish lowland sheepdog	1
Bobbie	1.5	Female[s]	Cairn terrier	1
Kenny	0.9	Male[n]	Cairn terrier	1
Rosie	7.5	Female[s]	Bearded collie	1
Willow	4	Female[s]	Bearded collie x border collie	1
Mac	1	Male[n]	Jack Russell terrier cross	1
Mojo	3	Male[n]	Border collie	1
Betsy	4.5	Female[s]	Beagle	1
Casey	0.75	Female	German shepherd	1
Ollie	2.5	Male[n]	Maltese x Australian silky terrier	1
Ruby-1	1	Female[s]	Labrador retriever x border collie	1
Mana	1	Male[n]	Mastiff x Labrador retriever	1
Rover	7.5	Male[n]	Labrador retriever	1
Jess	6.5	Female[s]	Huntaway x collie	1
Badger	3	Male[n]	Fox terrier cross	2
Nikki-1	10	Female[s]	Labrador retriever x collie	2
Keesha	11.5	Female[s]	German shepherd	2
Floss	2.5	Female	Border collie	2
Cooper	1	Male[n]	Australian cattle dog cross	2
Mica	1	Female	Australian cattle dog x heading dog	2
Lulu	2.5	Female[s]	Standard poodle	2
Jezebel	10	Female[s]	Fox terrier	2
Skyla	0.5	Female	Poodle x golden retriever	2
Darth Vader	3.5	Male[n]	Staffordshire terrier cross	2
Cora	0.9	Female	Labrador retriever	2
Cocoa	5	Female[s]	Labrador retriever	2
Ankh	2.5	Female	German shepherd	2
Jazz	4	Female[s]	Jack Russell	2
Nikki-2	4	Male[n]	Border collie	2
Bella-1	0.4	Female	Schnauzer x West Highland terrier	2
Ruby-2	4	Female[s]	Border collie	2
Honey	5	Female	Beagle	2
Eve	4.5	Female[s]	Fox terrier	2
Daisy	1	Female[s]	Crossbreed	2
Marama	12	Female[s]	Huntaway x Rottweiler	3
Te Po	4	Male[n]	Border collie cross	3
Riley	3	Female[s]	Labrador retriever	3
Jewel	5	Female[s]	Fox terrier	3
Mara	6	Female[s]	Corgi cross	3
Kenya	1	Female[s]	German shepherd	3
Lani	8.5	Female[s]	German short-haired pointer	3
Penny	3	Female	Siberian husky	3
Spice	4	Female	Siberian husky	3
Daphne	2	Female[s]	Australian cattle dog x Labrador retriever	3
Jed	7	Male[n]	Labrador retriever	3
Boy	1	Male[n]	Fox terrier	3
Maisy	1	Female	Newfoundland	3
C.C.	6	Female	Dalmatian	3
Moses	10	Male[n]	Huntaway x Labrador retriever	3
Bonnie	11.5	Female[s]	Boxer cross	3
Elmo	9	Male[n]	Huntaway x German shepherd	3
Bella-2	7	Female[s]	Border collie cross	3
Roo	3	Female[s]	Australian kelpie x schipperke	3
Juno	3	Female[s]	Fox terrier x Jack Russell terrier	3

[a]Condition 1 = 0 s delay to reinforcement (beep and food); Condition 2 = 1 s delay to reinforcement (beep and food); Condition 3 = 0 s delay to beep, 1 s delay to food.

[s]Spayed, [n]neutered.

This study was approved by the University of Waikato School of Psychology Research and Ethics Committee (protocol number 11:43), and by the University of Waikato Animal Ethics Committee (protocol number 846). All dog owners were given an information sheet outlining the broad aims of the research, the opportunity to ask questions of the researcher, and signed a consent form prior to the experiment. Dog owners who were students in first year psychology courses were given 1% course credit for each experimental day their dogs were involved, up to a maximum of 4% per course.

Inclusion criteria. The criteria for dogs being included in this study were that the dogs were not distressed when left in a new environment without their owners, they were motivated to work for food, they had current vaccinations, and they were over five months of age.

Dogs were withdrawn from the study for three reasons. Firstly, if the food was not reinforcing for a dog (i.e., the dog was not interested in eating it) and/or it could not be trained to use the feeder reliably within one session or less than 100 pieces of food, then the dog was excluded from further use. Reliable use of the feeder is explained in the section *Procedure* below.

Dogs were also withdrawn if they showed persistent signs of distress. These included ongoing vocalisation (whining and/or barking); continual pawing and/or jumping at the experimental pen door; or a lack of exploratory behaviour in combination with a stiff body, tail held low or tucked beneath the body, ears flat, excessive panting, or a tightly closed mouth and lip licking. Some dogs displayed signs of distress as soon as they arrived at the training facility, or began to exhibit such signs as soon as their owners left the premises (measures were taken to attempt to alleviate any distress, see the section *Procedure* for details). Other dogs

were frightened by the sound of the beep or the feeder opening to deliver the food (see *Study Location and Apparatus*). A small number of dogs appeared to be coping until the screen was completely lowered between the experimental pen and the adjacent pen in which the researcher was sitting and the dogs could no longer see the researcher (see the section *Procedure*). Some dogs did not present any significant signs of distress until the first experimental session was underway.

Finally, if any dogs performed behaviours that risked the equipment being damaged (e.g., vigorous pawing at equipment) or future experiments being compromised (e.g., urination in the experimental pen), they were also withdrawn from the study.

Once a dog had been withdrawn from the study, their owner was contacted and the dog was collected at the owner's earliest convenience. Fifty one dogs involved in 70 sessions were withdrawn from this study. No data are presented for the dogs who were excluded from the study.

Study location and apparatus. This study was carried out at a facility at the University of Waikato, Hamilton, New Zealand, inside a room that contained four large pens (Figure 4.1).

The pens were arranged in a row in the training room. They had concrete floors with steel mesh walls and doors through which the dogs could see. The experiments were conducted in one of the pens at one end of the row, the 'experimental pen' (Figure 4.1). This experimental pen contained a bowl of water. A shallow dish also sat on the ground; it was attached to the wall between the experimental pen and the adjacent pen, and positioned underneath a short tube attached to an automated feeder (located in the adjacent pen; Figure 4.2). The

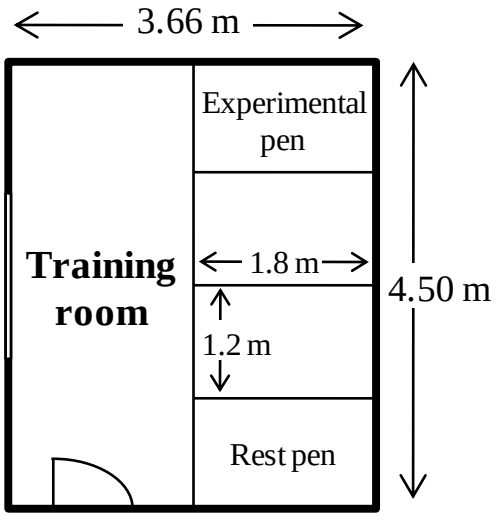

Figure 4.1. The training room where this study was carried out.

Figure 4.2. The experimental pen apparatus and layout.

food used in this study was a commercially made dog roll, Possyum. This dog roll was cut into small cubes, approximately 8 x 8 mm.

The pen adjacent to the experimental pen was where the researcher sat for the duration of the experiments. The automated feeder was situated in this pen. This feeder was connected to a computer via a USB cable, and allowed for the delivery of one piece of food at a time. When the feeder was activated, an attached speaker emitted a beep (for 100 ms) 1 ms before the food was released; this beep and the food release were always paired together. (For the first seven dogs in this procedure, the researcher dropped a piece of food into a short tube running from the adjacent pen into the experimental pen above the food dish as soon as the beep was produced, due to an equipment delay. From the eighth dog onwards, this tube was replaced by the automated feeder. No differences in the dogs' results were observed.) A carpet screen was attached to the wall between the experimental pen and the adjacent pen; this screen could be half- or fully-lowered to allow or prevent the dog viewing the researcher, as required.

Two plastic boxes were used in this experiment: one yellow and the other blue; 21.5 cm wide, 23 cm long, and 20 cm high (Figure 4.2). These boxes were five-sided with an open top. Infrared sensors (transmitters and receivers) were placed inside these boxes, along the top edges of all four walls. These sensors were connected to the computer sitting in the adjacent pen. When something (e.g., a dog's nose) passed between the sensors, breaking the infrared beams, this event was transmitted to the computer and recorded by a computer programme. The boxes were attached to the wall in the experimental pen on either side of the dish (approximately 10 cm from the dish): the blue box to the left of the dish and the yellow box to the right.

The computer programme was purpose-written software. It controlled the experiment and the external ports (USB); the boxes (input) and the feeder (output) were connected via a port. It recorded the times at which the infrared beams were broken in either box, distinguishing between the two boxes. The programme also controlled the activation of the beep and feeder, and could be programmed to insert a delay between the infrared beams being broken and the activation of the beep and feeder.

A video camera (Panasonic® HC-V100) was placed on a tripod outside the door to the experimental pen at a height of 1.47 m, filming the entire interior of the pen. This camera was also connected to a television that sat facing the adjacent pen so that footage from inside the experimental pen could be viewed by the researcher in real time. A second video camera (Flip Video™) was outside the experimental pen door, positioned 30 cm off the ground. This camera recorded the dogs' head movements into the boxes during the experimental sessions. The original intention was to coordinate the footage from both cameras for later analysis, but the footage from first camera was deemed the most useful and thus only that was used. A lamp was positioned on top of the wall between the experimental and adjacent pens, shining down onto the dish and the boxes to provide better lighting for the filming.

The pen at the other end of the row, furthest away from the experimental pen, was where the dogs rested when not participating in an experiment. This 'rest pen' contained a bowl of water, soft bedding, a plastic moulded bed, and dog toys. If an owner had brought in their dog's own bedding and toys, these were also placed in the rest pen.

A radio played music for the duration of the dogs' time at the facility to help mask extraneous sounds (but it did not cover the sound of the apparatus).

Design. The yellow box was designated as the 'target' box, and it was interacting with this box for which the dogs would receive positive reinforcement. When the infrared beams inside this box were broken (e.g., a dog put its head inside the box), the beep and feeder were activated after a pre-determined delay. The blue box was designated as the 'non-target' box; when its infrared beams were broken this was recorded by the computer programme, but there was no consequence for the dog: the beep and feeder were not activated.

Subjects were assigned to one of three conditions in which dogs performed the experimental task (breaking the infrared beams inside the target box) and then were presented with positive reinforcement (a beep followed by a food treat) at different delays, with the same delay being set for the entire session (Table 4.1). The conditions were: a 0 s delay to reinforcement, with the beep and food being delivered one after another (this was the control condition, Condition 1); a 1 s delay to the beep followed immediately by the food (Condition 2); and a 0 s delay to the beep and then a 1 s delay to the food (a signalled delay; Condition 3). Although random assignment to each of the conditions would have been preferable to avoid any confounds, the dogs were assigned to conditions depending on the current equipment set up; 20 dogs per condition. The first seven dogs recruited were originally part of the pilot study's final procedure (see Appendix B), and thus were put into Condition 1. The next 20 dogs were assigned to Condition 2; the following 13 dogs were put into Condition 1; and the final 20 dogs were assigned to Condition 3.

Positive reinforcement was delivered on a fixed ratio (FR) 1 schedule in all conditions (i.e., they received reinforcement for each response). All delays were non-resetting; however, the type of response and length of delays were such that the dogs were not able to respond, eat from the feeder, and then respond a second time within the delay period – which avoided a reduction in the rate of reinforcement. The computer programme was set to limit the experimental sessions to 200 activations of the beep and feeder (i.e., when 200 pieces of food, approximately 100 g, had been delivered), or 30 min, whichever occurred first.

The dogs being tested in Condition 1 underwent one pre-experiment training session and then one or two experimental sessions (see *Procedure* below). If dogs failed to meet the learning criteria (see *Analysis* below) after their first experimental session then they performed a second session. The dogs in Condition 2 and Condition 3 also underwent one pre-experiment training session and then one or two experimental sessions (depending on their performance). If these dogs did not learn the task within two experimental sessions, they were brought back to the training facility on another day to be tested in Condition 1. On this second experimental day, these dogs again underwent one pre-experiment training session and then one or two experimental sessions. (Note: the initial procedure allowed three experimental sessions, and so the first four dogs recruited for Condition 2 (Keesha, Badger, Nikki-1, and Floss) completed three sessions in their conditions. This was later changed to two experimental sessions.)

Procedure. Dog owners were encouraged to bring their dogs to the training facility for an informal meeting on a day prior to the experimental day(s). This was to give the dogs an opportunity to habituate to the researcher and the experimental room. The dogs were hand fed some pieces of food by the researcher

during this time. Whilst the dogs were allowed to explore the experimental and adjacent rooms freely, they did not have access to the experimental pen.

On experimental days, dogs arrived at the training facility between 7 am and 6 pm, and they stayed for two to nine hours, depending on the owners' schedules. Owners were not asked to modify their dogs' normal feeding routine, but 95.50% of dogs had not received food for at least one hour prior to the start of the pre-experiment training, and the average fasting time was just under six hours. One dog was fed ad libitum.

Upon arrival at the training facility on an experimental day, the researcher spent at least 10 min talking to the dog's owner. During this time the owner put their dog into the rest pen, and completed paper work consisting of a consent form and details on when the dog was last fed. As each owner left the facility, the researcher would take the dog into an adjacent room to distract the dog while its owner drove away, and to weigh the dog. The dogs' weights were recorded to ensure no significant fluctuations occurred during the course of the study, as per The University of Waikato's Standard Operating Procedure for working with dogs. The researcher spent 10 to 40 min (as required based on each dog's behaviour) playing and otherwise interacting with the dog to facilitate it becoming comfortable with the researcher. The dog was then taken outside for an on-lead walk, giving it the opportunity to urinate or defecate, and to further help it relax at the facility and in the presence of the researcher. At the conclusion of this, the researcher returned the dog to the rest pen.

Pre-experiment training. One session of pre-experiment training was conducted before each day's experimental session(s). The purpose of this training was for the dogs to learn that pieces of food were delivered via the feeder, with

the treats dropping through the tube and into the dish on the ground in the experimental pen; to associate the beep with the appearance of the food (so that the beep acted as a conditioned reinforcer); and for the dogs to become comfortable being in the experimental pen when the screen was lowered and the researcher was out of sight. These sessions were filmed for later review.

The dogs were led into the experimental pen and allowed to explore freely. This pen was empty except for the dish associated with the feeder and a bowl of water. The researcher closed the experimental pen door and sat in the adjacent pen, where the two boxes were placed. The screen attached to the mesh wall between the experimental pen and the adjacent pen was only half-lowered, so the dog could see the researcher sitting on the floor of the adjacent pen. A three- to four-step shaping procedure was then used to train the dogs to take food when delivered by the feeder (following a beep), that is, for them to learn an association between the sound of the beep and the feeder and subsequent food delivery. Each step was repeated until the dogs were responding reliably (i.e., a minimum of 10 times in a row).

The first step involved the researcher breaking the infrared beams in the target box by hand, thus activating the beep and feeder (which did not contain food at this stage), and immediately reaching through the wall into the experimental pen and throwing a piece of food into the dish. If a dog failed to eat from the dish, hand movements (e.g., waving a hand and pointing towards the dish) were used to direct the dog's attention towards the piece of food in the dish. Before moving onto the next step in the shaping procedure, it was expected that a dog would eat a piece of food as soon as it was dropped into the dish, or as soon

as the hand gesture towards the food was made. This was repeated a minimum of 10 times.

Step two was similar to the first step with regards to hand gestures, but food was delivered via the feeder. The feeder was pre-loaded with a piece of food by the researcher, and when activated the beep would sound and then feeder would open and the piece of food would drop down the tube and land in the dish in the experimental pen for consumption. The researcher re-loaded the feeder with another piece of food after each activation. (This re-loading was done while the dog was eating the piece of food from the just-prior activation, thus the sound of the dog eating the food masked the noise of re-loading the feeder.) This step was generally not deemed necessary and thus skipped during most dogs' training, but if the researcher judged it was required then it was repeated at least 10 times.

In the third step the food was delivered via the feeder (so a beep and then food was delivered), but no hand gestures were made. At this stage it was expected that a dog would readily orient itself towards the dish upon hearing the beep and the feeder activate, and then eat the food as it dropped into the dish. This was repeated until the dog was responding to the sound of the beep and feeder with a latency of five seconds or less between the beep being emitted and the dog moving towards the dish.

The screen between the experimental pen and the adjacent pen was fully lowered in the fourth and final stage of this shaping procedure so that the dogs could no longer see the researcher. The researcher continued to break the infrared beams in the target box by hand, thus activating the beep and the pre-loaded feeder. This was again repeated until the researcher was satisfied that the dog was moving towards the dish within five seconds of the beep and feeder being

activated, and also that the dog was not distressed by no longer being able to see the researcher.

If a dog failed to eat a piece of food within five seconds more than three times at any stage in the procedure, then the researcher returned to the previous step. If a dog failed to complete this pre-experiment training within the delivery of 100 pieces of food then it was withdrawn from the study.

At the end of this pre-experiment training, the dog was removed from the experimental pen and returned to the rest pen.

The experiment. The two boxes had approximately 100 g of Possyum dog roll (cut into cubes) placed in them on the evening prior to the experiment so that the boxes contained this food for at least 12 hours prior to the first experimental session on the following day. This food was emptied out of the boxes immediately before the first session. (If more than dog was tested on the same day, the 100 g of food was replaced in the boxes in between dogs.) It was hoped that the scent of the food would be attractive to the dogs and act as a 'lure', encouraging the dogs to sniff inside the boxes.

The feeder was pre-loaded with one piece of food and both cameras were started recording before the dog entered the experimental pen. The dog was taken from the rest pen to the experimental pen, and as the dog entered the experimental pen the researcher started the computer programme and the experimental session began. The researcher closed the door to the experimental pen and sat down quietly in the adjacent pen (the screen remained completely lowered between the two pens so the dog could not see the researcher). The dog was allowed to explore the experimental pen freely. The researcher remained as quiet as possible for the duration of the experimental session to avoid distracting the dog. If a dog

displayed any behaviour that gave cause for the researcher to stop the session, then the researcher removed the dog from the experimental pen and returned it to the rest pen. Otherwise the experiment was allowed to continue to the end. The researcher took notes on the dogs' behaviour during the experimental session. The dog was then removed from the experimental pen and returned to the rest pen.

All pens were cleaned with Virkon® S after each dog had finished all of their sessions for the day, and the experimental boxes were cleaned as required.

Data Analysis. The main measures used to assess the effects of the delayed reinforcement were whether the dogs learned the task, the time taken for dogs to learn the task, and their response rates. There appears to be an absence of an accepted measure of when animals have learned a new response across studies (McNamara, Johnson, Tate, Chiang, & Byrne, 2015), and it is frequently poorly defined, for example, "The number of sessions required for responding to develop varied" (Lattal & Metzger, 1994, p. 37). Given a lack of a defined measure of task acquisition in the literature, a definition of learning was developed based on observations from the pilot study (Appendix B). Dogs were considered to have learned the task when there were five seconds or less between each response (infrared beam breaks), for 10 responses in a row. (Six seconds or less between responses was used in Conditions 2 and 3 to compensate for the delay.) Dogs were also considered to have learned if they responded repeatedly (for at least three minutes) at a steady rate, as determined by visually assessing the cumulative response rate graphs.

The results of each condition were expressed as the percentage of dogs who did or did not learn the experimental task. SigmaPlot (version 12.5) was used to construct cumulative frequency graphs of each dog's data. (Note: some dogs

who learned the task broke the target box's infrared beams a second time with their ears, neck hair, or tags on their collars as they removed their head from the box after performing a response. These data were excluded from analyses in all conditions by checking the video footage, and this accounts for when dogs' cumulative responses are less than 200 within a session when the dogs learned the task.) Chi-square analysis was used to compare the proportion of dogs in each condition who learned the task.

The time taken for each dog to meet the learning criterion based on response rate (10 responses in a row with five seconds or less in between them) was determined. A Kruskal-Wallis test, with post-hoc pairwise comparisons, was used to compare these task acquisition times across all three conditions.

The response rates of the dogs who learned the task were calculated using the number of target box responses and the time they spent responding. Very long interresponse times were removed from the response rate calculations. To do this, data for each dog were graphed as box plots and the extreme outliers (defined as three box lengths from the end of the box) were removed. The remaining time periods were used in the response rate calculations. A Kruskal-Wallis test, with post-hoc pairwise comparisons, was used to compare the response rates from the sessions in which dogs learned the task, across the three conditions.

IBM® SPSS® Statistics (version 21.0.0.0) was used for all statistical analyses. Statistical significance was accepted at $p < .05$ for all tests.

Results

Sixty dogs participated in 162 sessions across the three conditions in this study.

Condition 1: 0 s Delay

Dogs who learned the task. In Condition 1, 60.00% (12/20) of the dogs responded steadily and learned the experimental task (Figure 4.3). Nine of these 12 dogs met the learning criterion of responding 10 times in a row with five seconds or less in between responses; two other dogs were also established to have learned the task under the cumulative response rate-based criterion (Figure 4.3). One dog's data were lost due to a technical error; however, she was observed to respond 200 times at a steady rate and thus was deemed to have learned the task. The average time taken to meet the learning criterion of responding 10 times in a row with five seconds or less in between responses was 9:18 min, which ranged from 3:11 to 18:22 min (Table 4.2).

Two of the dogs learned non-standard responses: rather than breaking the infrared beams with their heads, Willow and Niia broke them repeatedly with the long hair on their ears and around their neck, respectively. Once these unorthodox behaviours were established, these two dogs continued to respond in these ways consistently until the end of their sessions.

The response rates of the dogs who learned in Condition 1 (as their original condition) ranged from 7.36 to 24.50 responses per minute; the average was 15.91 responses per minute (Table 4.2).

Dogs who didn't learn the task. Eight out of 20 dogs (40.00%) failed to learn this task after two sessions (Figure 4.4). The majority (six out of eight) of these dogs responded in the target box at the start of both sessions. The exceptions

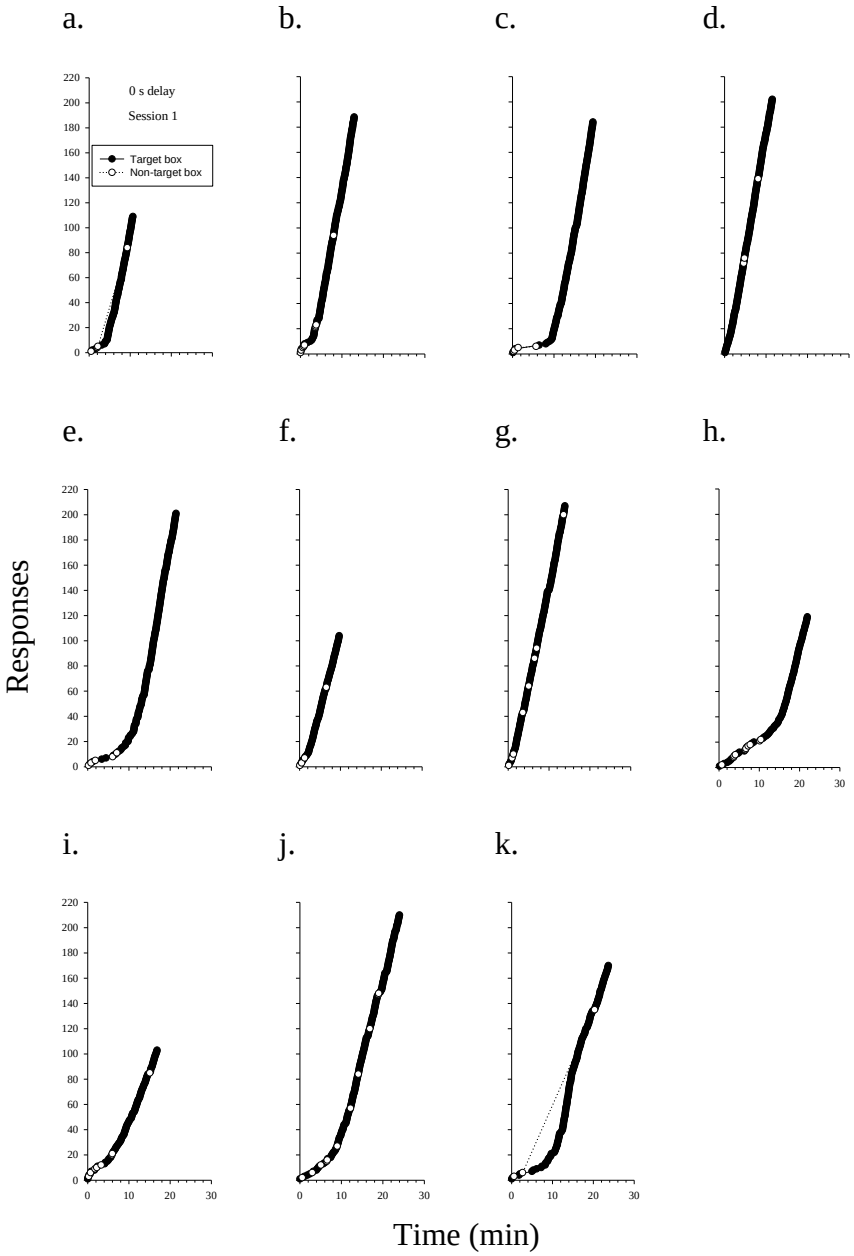

Figure 4.3. Cumulative responses performed by Charles (a), Flint (b), Jess (c), Mana (d), Mishka (e), Mojo (f), Ollie (g), Rippley (h), Rosie (i), Sasha (j), and Willow (k) with a 0 s delay to delivery of positive reinforcement in Condition 1 (control). Note: a 12th dog, Niia, did learn the task but her data were lost due to a technical error.

Table 4.2

Dogs' Task Acquisition Times and Response Rates for the Sessions in Which They Met the Criteria for Learning the Experimental Task

Dog	Condition 1		Condition 2		Condition 3	
	Acquisition time	Response rate	Acquisition time	Response rate	Acquisition time	Response rate
Charles	4:55	17.21				
Flint	4:57	20.57				
Jess	13:20	20.00				
Mana	3:11	19.32				
Mishka	14:06	24.50				
Mojo	5:50	13.51				
Niia	Data lost	Data lost				
Ollie	4:51	17.46				
Rippley	See graph	9.40				
Rosie	See graph	7.36				
Sasha	18:22	14.32				
Willow	14:13	11.36				
Average	9:18	15.91				
Badger[a]	9:11	23.81				
Floss[a]	2:07	24.74				
Honey[a]	8:46	20.00				
Mica[a]	5:29	20.53				
Nikki-1[a]	See graph	13.16				
Ruby-2[a]	3:39	18.64				
Average	5:50	20.15				
Bonnie[b]	3:35	24.10				
C.C.[b]	8:32	15.42				
Daphne[b]	5:13	15.31				
Jed[b]	3:06	22.61				
Kenya[b]	9:53	18.45				
Moses[b]	3:49	19.70				
Spice[b]	5:21	18.04				
Average	5:38	19.09				
Ankh			30:14*	12.50		
Cocoa			43:57	9.58		
Cooper			9:09	6.30		
Cora			15:13	13.16		
Keesha			See graph	7.34		
Average			24:38	9.78		
Elmo					45:36	10.12
Jewel					29:34	12.40
Lani					45:36	13.14
Maisy					See graph	8.24
Marama					33:46	11.78
Penny					12:43	11.86
Roo					11:59	12.69
Te Po					See graph	9.42
Average	7:16	17:90			29:52	11.20

Note. Condition 1 = 0 s delay to all reinforcement, Condition 2 = 1 s delay to all reinforcement, Condition 3 = 0 s delay to the beep and 1 s delay to food. Acquisition time is measured in minutes, seconds; response rate is responses per minute. Times exceeding 30 minutes indicates that learning criteria met in the second sessions. See graph = dogs who were determined to have learned upon visual inspection of their graphs.

[a]Originally in Condition 2 but failed to learn the task until switched to Condition 1.

[b]Originally in Condition 3 but failed to learn the task until switched to Condition 1.

*This dog's first session was stopped at 15 minutes due to equipment problems.

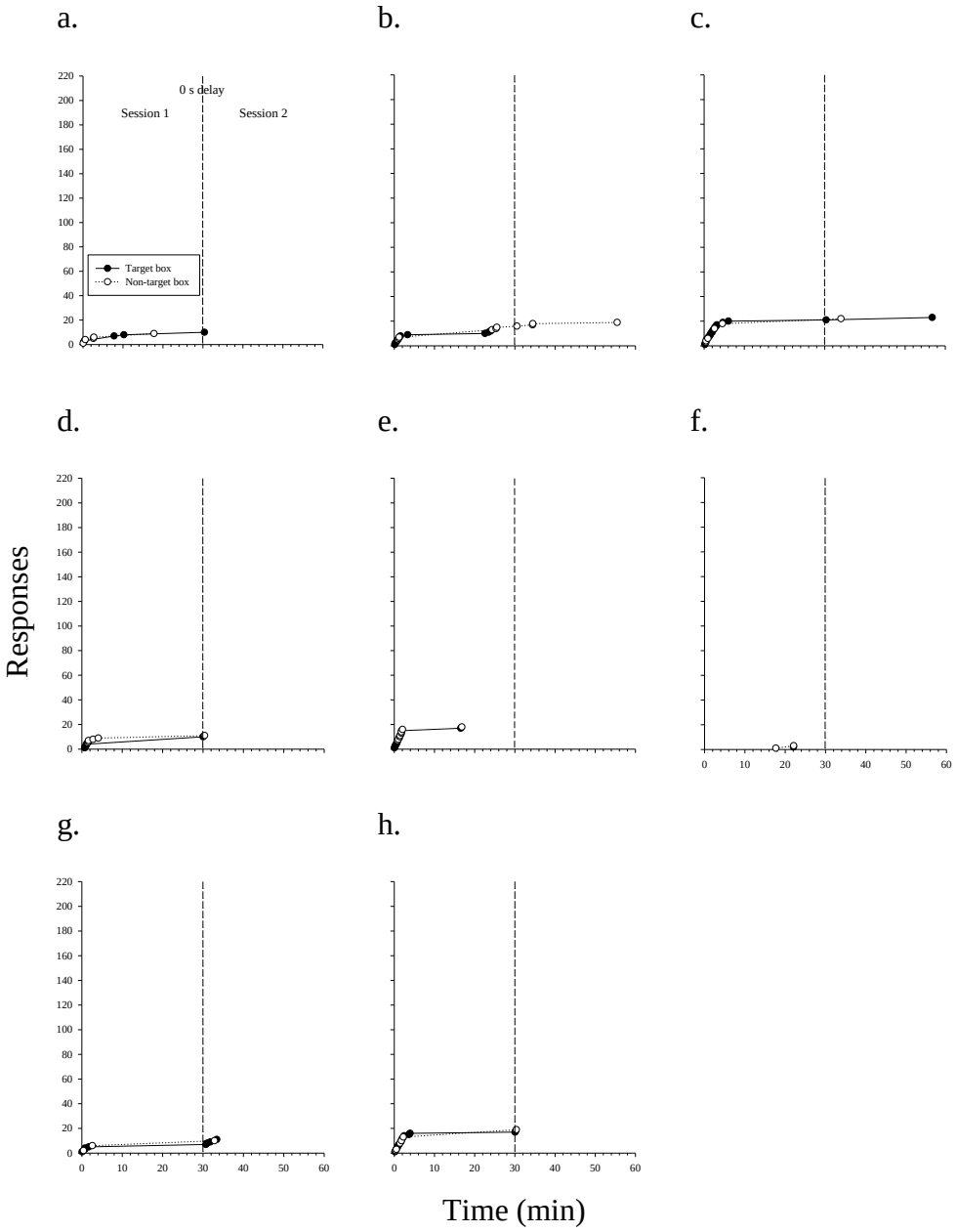

Figure 4.4. Cumulative responses performed by Betsy (a), Bobbie (b), Casey (c), Kenny (d), Mac (e), Romsey (f), Rover (g), and Ruby-1 (h) with a 0 s delay to delivery of positive reinforcement in Condition 1 (control). The broken vertical lines denote a change of sessions.

to this were Romsey and Mac: Romsey did not make his only target box response until 22:03 min into the first session, and both Mac and Romsey did not respond at all in their second session.

Three dogs, Casey, Mac, and Ruby-1, performed 15, 9, and 11 responses respectively at the start of their first session before ceasing to respond any further in that session. Most of the non-learning dogs lay down after any early-session responding and investigations of the experimental pen.

Condition 2: 1 s Delay

Dogs who learned the task. Of the 20 dogs in Condition 2, 25.00% (5) of them learned the task; including one dog who met the learning criterion based on visual appraisal of her graphed data (Figure 4.5). The average time taken to learn the task (based on response rate criterion) was 24:38 min, ranging from 9:09 to 43:57 min (Table 4.2).

One dog learned to respond in an unconventional way. Ankha consistently broke the infrared beams by mouthing (i.e., chewing and licking) the top edge of the target box, as well as putting her foot inside the box.

The response rates of these dogs ranged from 6.3 to 13.2 responses per minute; the average was 9.8 responses per minute (Table 4.2).

Dogs who didn't learn the task: Switched to Condition 1. The 15 dogs who did not learn the task with a 1 s delay to positive reinforcement were then tested in the 0 s delay condition, and 40.00% (6/15) of these dogs subsequently learned the task (Figure 4.6). Six dogs met the learning criteria, including one via visual examination of their graphed data (Figure 4.6). Task acquisition (based on the response rate learning criterion) took place after an average of 5:50 min, ranging from 2:07 to 9:11 min (Table 4.2).

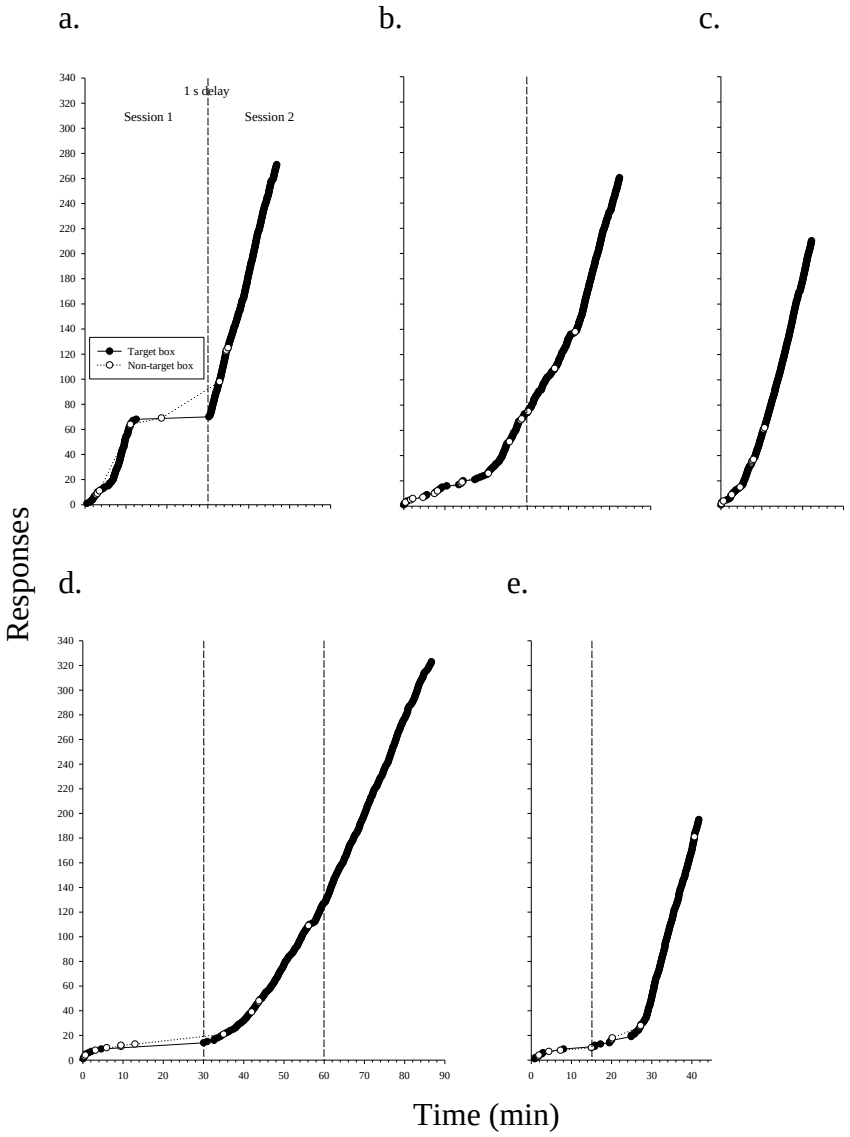

Figure 4.5. Cumulative responses performed by Cooper (a), Cocoa (b), Cora (c), Keesha (d), and Ankh (e) with a 1 s delay to delivery of positive reinforcement in Condition 2. The broken vertical lines denote a change of sessions. Ankh's first session was stopped early due to equipment problems. (Note that the y-axis scale in these figures has been adjusted to accommodate results from across multiple sessions.)

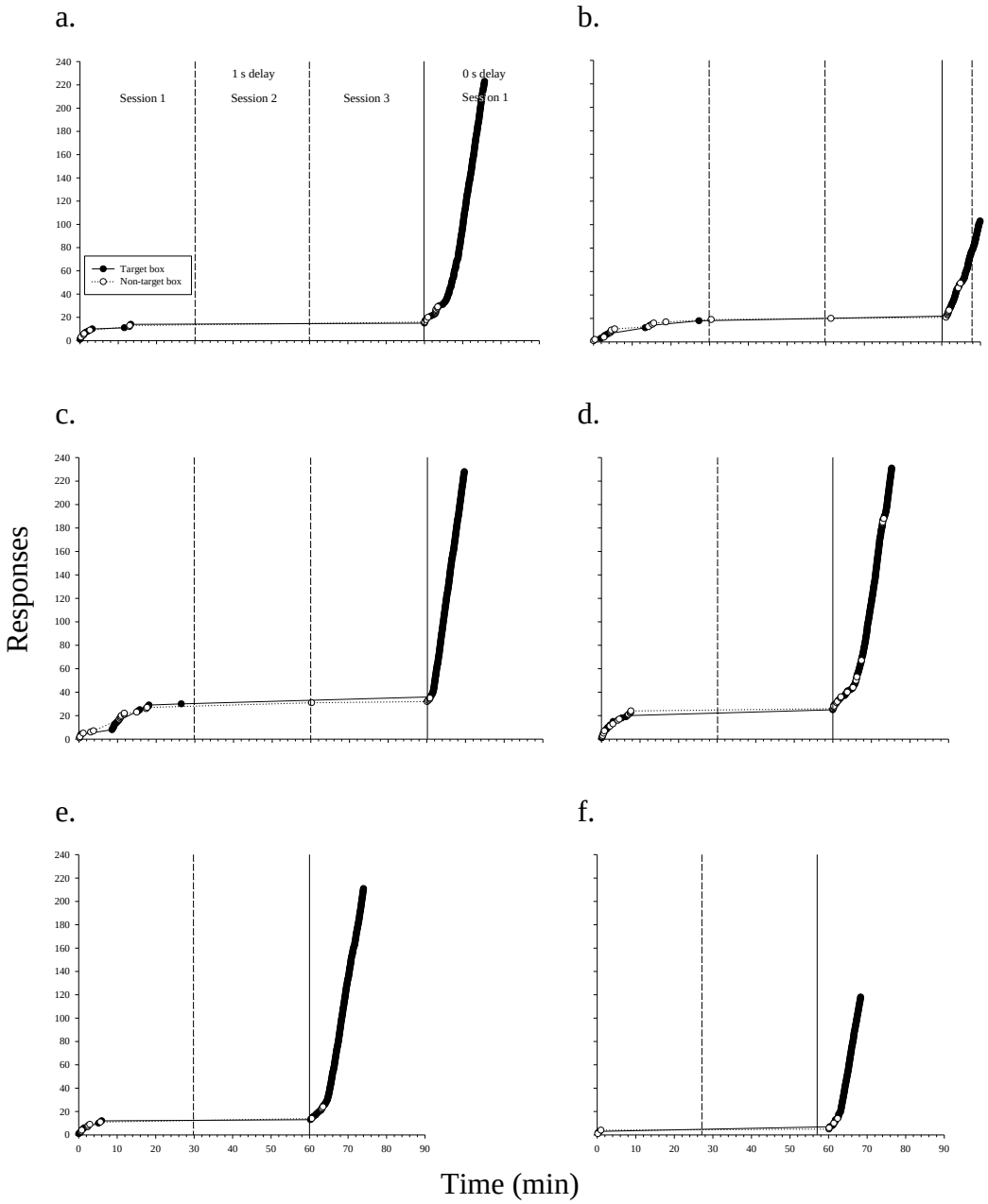

Figure 4.6. Cumulative responses performed by Badger (a), Nikki-1 (b), Floss (c), Honey (d), Mica (e), and Ruby-2 (f) with a 1 s delay to delivery of positive reinforcement in Condition 2, and then a switch to a 0 s delay to reinforcement (Condition 1, control). The broken vertical lines denote a change of sessions, and the solid vertical lines denote a change of conditions. Nikki-1's sessions in Condition 1 were cut short due to technical problems. (Note that the y-axis scale in these figures has been adjusted to accommodate results from across multiple sessions.)

The response rates of these six dogs ranged from 13.16 to 24.74 responses per minute, and were an average of 20.15 responses per minute (Table 4.2).

Nine dogs failed to meet learning criteria in first Condition 2 and then Condition 1 (Figure 4.7). Most of these dogs performed the task infrequently across their sessions; Jazz performed the most target box responses across all four sessions: 12 responses. The majority of the dogs in this sub-group spent most of their sessions at rest.

Condition 3: 0 s Delay to Beep, 1 s Delay to Food.

Dogs who learned the task. In Condition 3, 40.00% (8/20) of the dogs learned to perform the experimental task (Figure 4.8). Eight dogs met the learning criteria, two of which were determined upon visual assessment of their graphed cumulative response rate data (Figure 4.8). The task was learned in an average of 29:52 min (based on the response rate criterion); ranging from 11:59 to 45:36 min (Table 4.2).

The Condition 3 dogs' response rates ranged from 8.24 to 13.14 responses per minute; the average was 11.20 responses per minute (Table 4.2).

Dogs who didn't learn the task: Switched to Condition 1. The 12 dogs who were not successful in learning the task in this condition were then tested in the 0 s delay condition, and seven (58.33%) of these dogs then learned (Figure 4.9). All of these dogs learned the task in their first 0 s delay session, after an average of 5:38 min, ranging from 3:06 to 9:53 min (Table 4.2).

The average response rate for these dogs was 19.09 responses per minute, ranging from 15.31 to 24.10 (Table 4.2).

Five of these 12 dogs (25.00%) did not learn the task under either Condition 3 or when they were switched in to Condition 1 (Figure 4.10). Most of

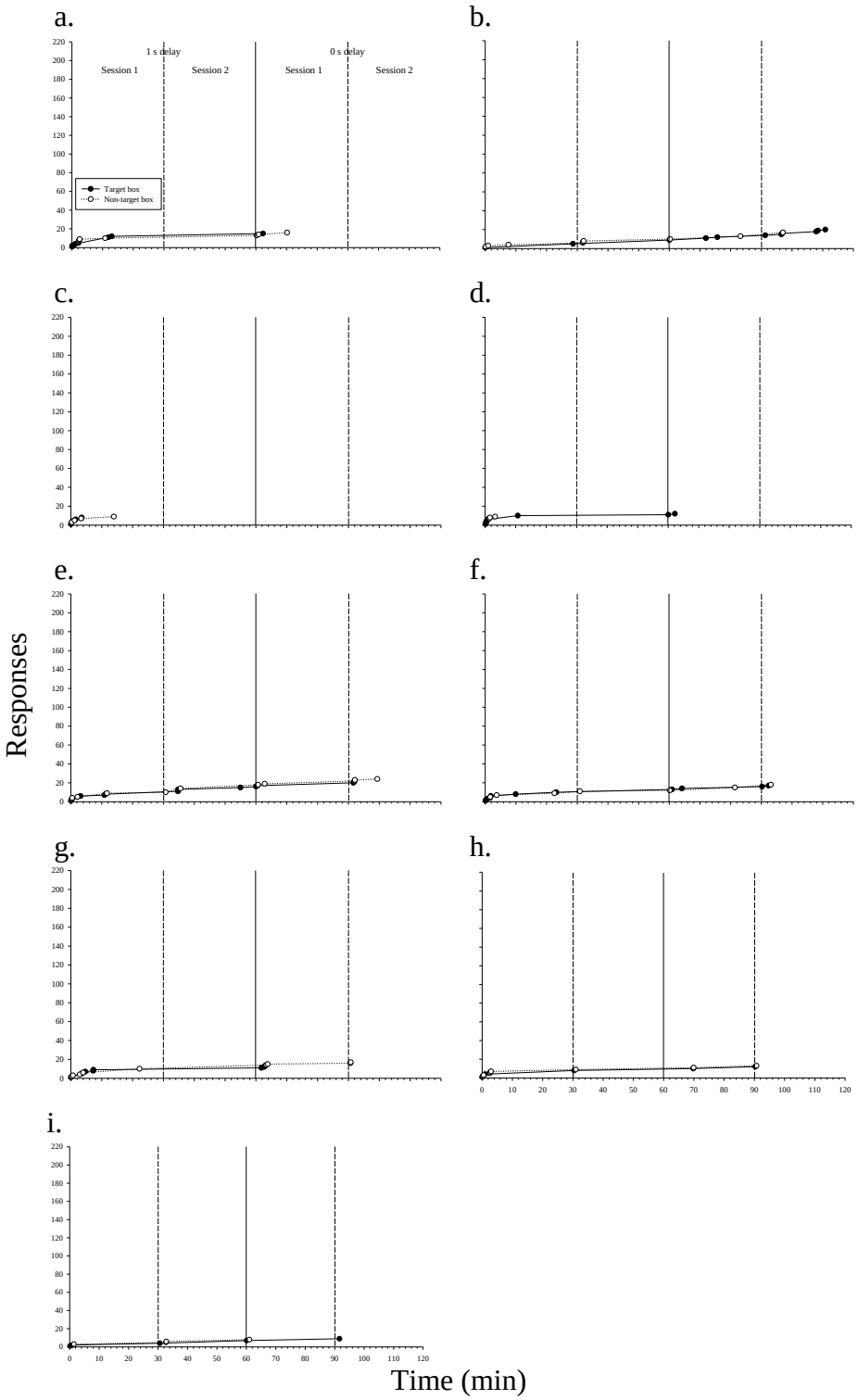

Figure 4.7. Cumulative responses performed by Bella-1 (a), Daisy (b), Darth Vader (c), Eve (d), Jazz (e), Jezebel (f), Lulu (g), Nikki-2 (h), and Skyla (i) with a 1 s delay to delivery of positive reinforcement in Condition 2, and then a switch to a 0 s delay to reinforcement (Condition 1, control). The broken vertical lines denote a change of sessions, and the solid vertical lines denote a change of conditions.

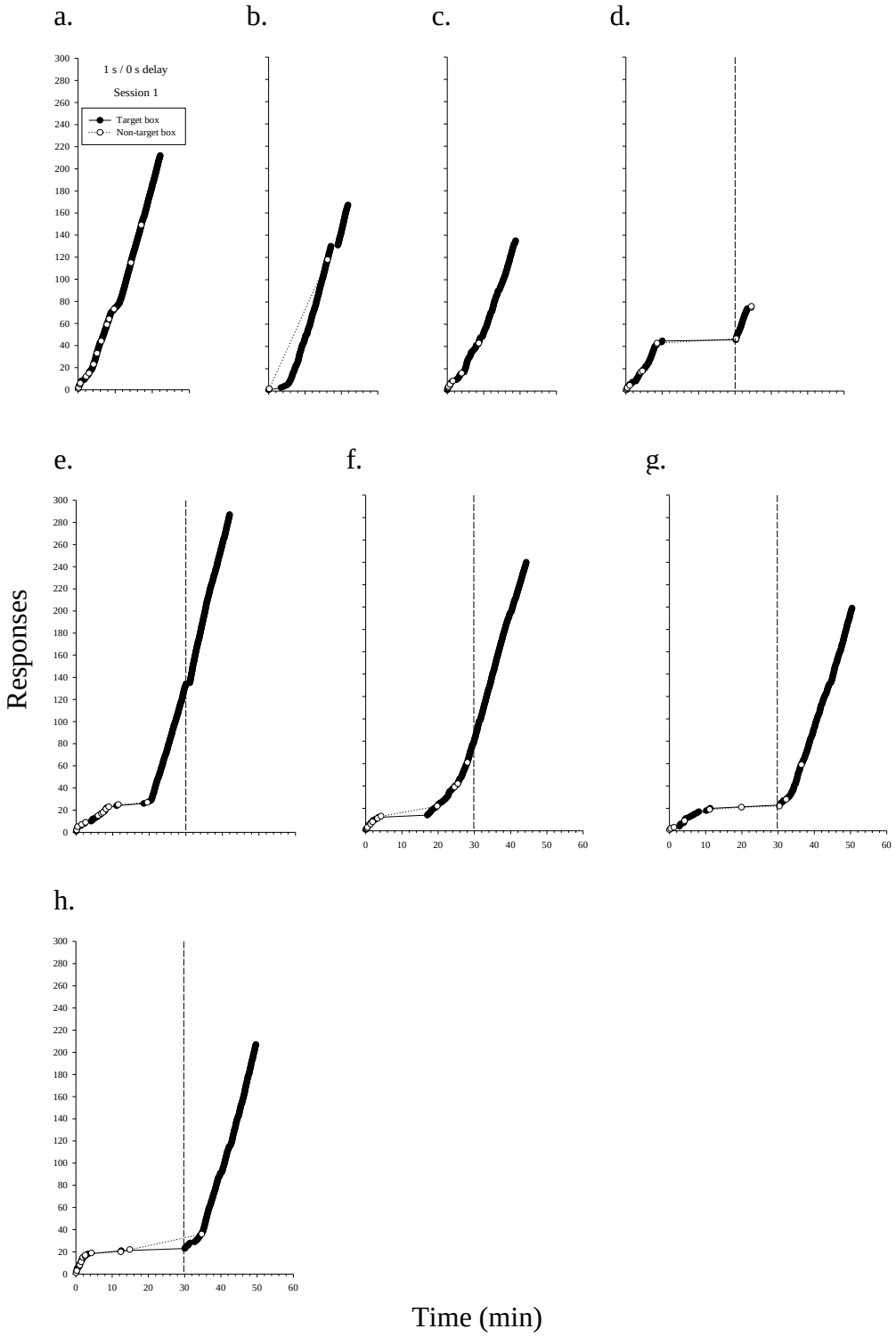

Figure 4.8. Cumulative responses performed by Penny (a), Roo (b), Te Po (c), Maisy (d), Jewel (e), Marama (f), Elmo (g), and Lani (h) with a 0 s delay to the delivery of the beep and a 1 s delay to the food in Condition 3. The broken vertical lines denote a change of sessions. (Note that the y-axis scale in these figures has been adjusted to accommodate results from across multiple sessions.)

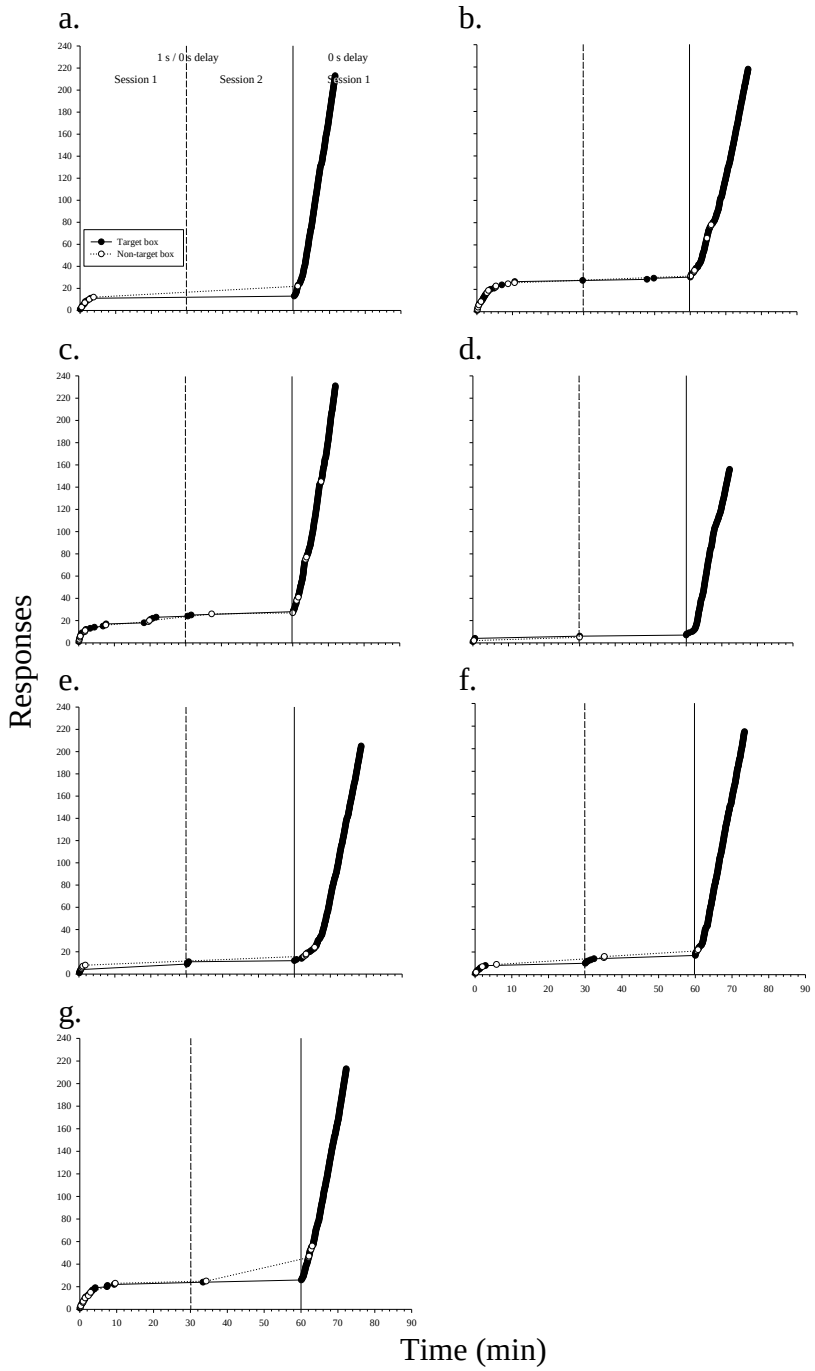

Figure 4.9. Cumulative responses performed by Bonnie (a), C.C. (b), Jed (c), Daphne (d), Kenya (e), Moses (f), and Spice (g) with a 0 s delay to the delivery of the beep and a 1 s delay to the food in Condition 3, and then a switch to a 0 s delay to reinforcement (Condition 1, control). The broken vertical lines denote a change of sessions, and the solid vertical lines denote a change of conditions. (Note that the y-axis scale in these figures has been adjusted to accommodate results from across multiple sessions.)

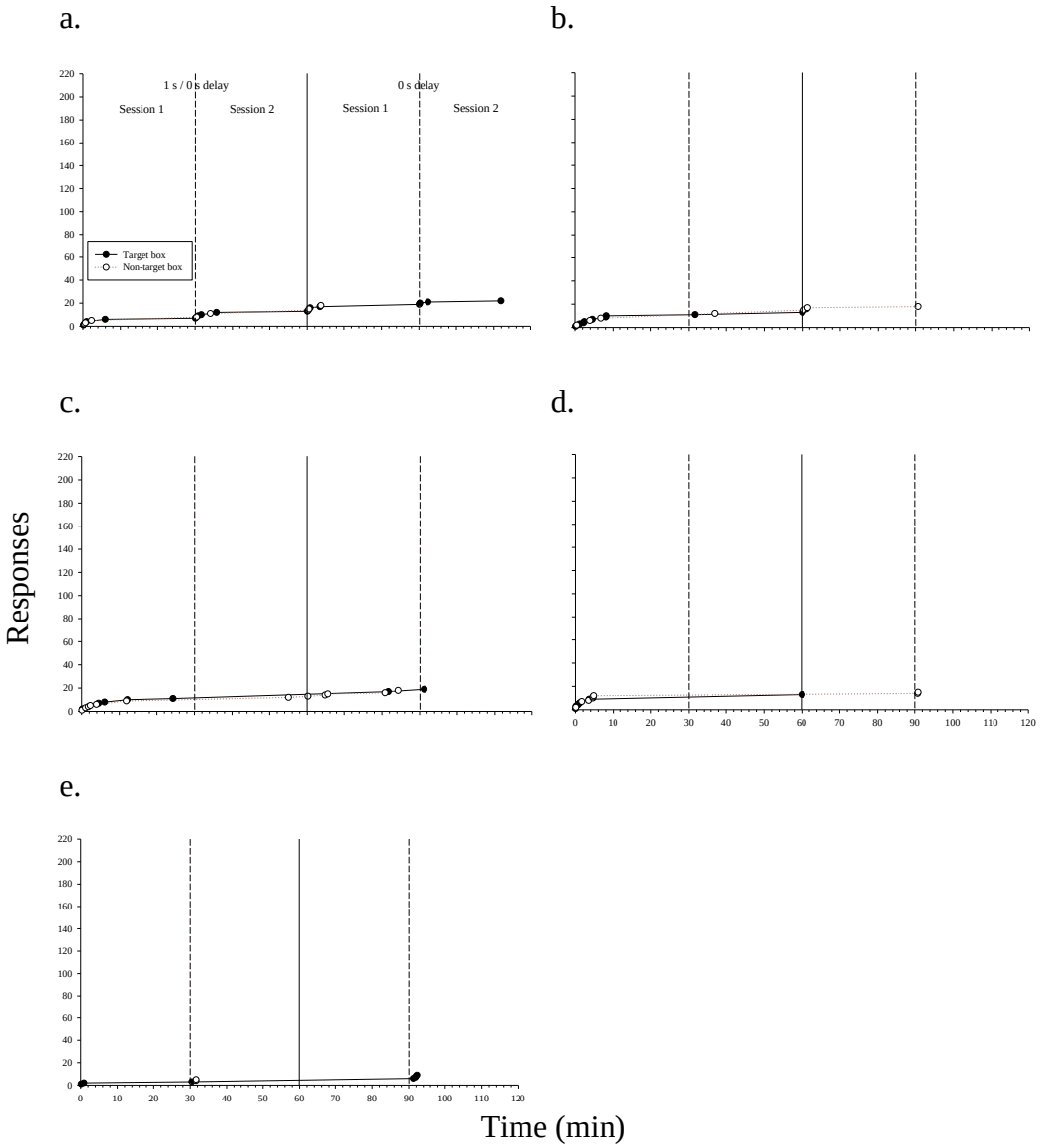

Figure 4.10. Cumulative responses performed by Bella-2 (a), Boy (b), Juno (c), Mara (d), and Riley (e) with a 0 s delay to the delivery of the beep and a 1 s delay to the food in Condition 3, and then a switch to a 0 s delay to reinforcement (Condition 1, control). The broken vertical lines denote a change of sessions, and the solid vertical lines denote a change of conditions.

these dogs showed a low level of target box responding in most sessions – the average number of responses per session was 2.31; Boy performed the highest number of responses (seven) in one session. These five dogs spent the majority of their experimental session time at rest.

Condition Comparisons

Differences in the number of dogs who learned (as determined by both criteria) the experimental task were observed across the three different delay conditions. The time it took the dogs to learn the task, and their response rates, also differed across conditions.

Learning. The results from all three experimental conditions are shown in Table 4.3. A larger proportion of dogs learned the task with 0 s delays to positive reinforcement (Condition 1; 60.00%), than those with a 1 s delay (Condition 2; 25.00%). Forty percent of the dogs learned with a 0 s delay to the beep and a 1 s delay to the food (Condition 3), falling between the data from the other two conditions. The difference in the proportion of dogs who learned in each condition approached statistical significance, χ^2 (2) = 5.074, p = .079.

When the results of all of the dogs who were put into Condition 1 (either as their initially-assigned condition, or when they failed to learn the task in Conditions 2 or 3 and were then switched to Condition 1) are considered as one group, 53.19% (25/47) of these dogs learned the experimental task (Table 4.3). Pooling the data from all of the dogs who experienced Condition 1 may introduce bias to the data. By failing to learn the task in Conditions 2 or 3, these dogs no longer constitute a random sample from the available pool of dogs. Their inclusion in Condition 1 could introduce bias due to these dogs effectively receiving more training or potentially being less able (or slower) to learn the task.

Table 4.3

The Number of Dogs Who Learned the Experimental Task Across All Three Conditions, Including Dogs Who Were Switched to Condition 1 After Failing to Learn in Their Original Condition

Condition[a]	Learned (N)			Total (N)
	Original condition	Switched from Condition 2 to Condition 1	Switched from Condition 3 to Condition 1	
1	60.00% (12/20)	40.00% (6/15)	58.33% (7/12)	53.19% (25/47)
2	25.00% (5/20)			25.00% (5/20)
3	40.00% (8/20)			40.00% (8/20)

[a]Condition 1 = 0 s delay to reinforcement (beep and food); Condition 2 = 1 s delay to reinforcement (beep and food); Condition 3 = 0 s delay to beep, 1 s delay to food.

However, as any bias is likely small, pooling the data makes use of all available data (which were not easily gained when participant retention is considered), and this shows how well all of the dogs who experienced this condition were able to learn the task.

Task acquisition time. The dogs who met the learning criterion (based on response rates) in Condition 1 did so after an average of 9:18 min (or 7:16 min with all Condition 1 data pooled; Table 4.2). The dogs in Condition 2 took almost three times longer on average to learn the task (24:38 min), and the average learning time for Condition 3 dogs was slightly longer still (29:52 min; Table 4.2).

The times taken until task acquisition were statistically significantly different across the three conditions, χ^2 (2) = 6.936, p = .031. Pairwise comparisons (with adjusted p-values) showed that there was a statistically significant difference between the task acquisition times in Condition 1 compared to Condition 3 (p = .045), but not between Condition 1 and Condition 2 (p = .220) or Condition 2 and Condition 3 (p = 1.000).

When the data for all dogs who experienced Condition 1 were pooled for comparison, the task acquisition times were statistically significantly different across all conditions, χ^2 (2) = 14.55, p = .001. Pairwise comparisons (with adjusted p-values) showed that there were statistically significant differences between the task acquisition times in Condition 1 compared to Condition 2 (p = .040), and between Condition 1 and Condition 3 (p = .003), but not between Condition 2 and Condition 3 (p = 1.000).

Response rates. The dogs' response rates varied across the three conditions. The average response rate was the highest in Condition 1 (15.91 responses per minute, or 17.90 when all Condition 1 data were pooled), with the average rates in Condition 2 (9.78) and Condition 3 (11.20) being substantially lower (Table 4.2).

There was a marginally significant association between the dogs' response rates across the three conditions, χ^2 (2) = 5.187, p = .075.

When all Condition 1 data were pooled there was a statistically significant difference between the dogs' response rates across the three conditions, χ^2 (2) = 15.12, p = .001. Pairwise comparisons with adjusted p-values revealed that there were statistically significant differences between response rates of the dogs in Condition 1 when compared to Condition 2 (p = .032), and Condition 3 (p = .002), but there were no statistically significant differences between Condition 2 and Condition 3 (p = 1.000).

Discussion

This study aimed to investigate the effect of delayed positive reinforcement on dogs learning a novel task. The hypothesis that delayed reinforcement will have a detrimental effect on dogs' learning was supported by the results. The hypothesis that signalled delays will result in behaviour comparable to that produced under conditions of immediate reinforcement was supported partially by the current findings.

The results showed that whilst over half of the dogs were able to learn the task with immediate reinforcement, very short delays were detrimental to the dogs' learning. Only 25.00% of the dogs who received reinforcement delayed by 1 s learned the task in this study. In comparison, 60.00% of all the dogs that received immediate reinforcement learned the task (53.19% when all Condition 1 data were pooled), as did 40.00% of the dogs who received the signalled delay (i.e., immediate conditioned reinforcement with unconditioned reinforcement delayed 1 s). Although the results were not statistically significantly different across the three conditions, the differences between them are consistent with the hypothesis that delayed reinforcement will have a negative impact on dogs' abilities to learn a novel task: the proportion of dogs who learned with immediate reinforcement was more than twice that following a 1 s delay, with the number who learned with the signalled delay falling between the data from the other two conditions. Additionally, the small sample sizes limit the ability to detect statistical significance. These findings indicate that delayed reinforcement is an important variable in dog training: it had a detrimental impact on the dogs' ability to learn the task, time taken to learn the task, and how frequently they performed the learned behaviour.

When compared to the delays in relevant studies with other species, it was a relatively short (1 s) delay that impacted negatively on the dogs' ability to learn a novel task in the present study. However, it was observed that 1 s was long enough for dogs to no longer have their heads in the target box when the reinforcement was delivered; in these circumstances the dogs' responses may have become non-contingent, interfering with the learning of the task.

Another reason for other studies finding that some animals can learn novel tasks with relatively lengthy delays could be attributable to behaviours that occur during those delays (see Lattal, 2010, for a discussion). For example, lever presses of inadequate strength to be registered by the apparatus have been observed during resetting delay periods with rats; these behaviours, very similar topographically to the target response, may then be adventitiously reinforced, contributing to task acquisition (McNamara et al., 2015). Additionally, comparable experiments have all exposed their subjects to more sessions than the current study; for example, the experiment by Lattal and Gleeson (1990) in which rats were exposed to 30 s delays ran for 20 sessions. This number of sessions was not practical for the current experimental design.

Previous studies indicate that signalled delays result in faster task acquisition times and higher response rates than those produced by comparable non-signalled delayed reinforcement (Critchfield & Lattal, 1993; Schlinger & Blakely, 1994), possibly due to the signals functioning as conditioned reinforcement. Although this basic pattern was observed in the current experiment (i.e., more dogs learned the task, task acquisition times were shorter, and response rates were higher, in Condition 3 compared to Condition 2), the differences were not large and were not statistically significant. One factor that may account for

this could be the saliency of the feedback. Casual observations suggested that the noise of the feeder operating – being more temporally contiguous with the food delivery – may have proved more salient feedback for some dogs than did the beep (the intended signal or conditioned reinforcer).

A noteworthy difference between the current study and other comparable delayed reinforcement experiments is the different species used, who have very different life histories; this may have contributed to differences in the results. Rats and pigeons have been used predominantly elsewhere; they are generally laboratory bred strains, and frequently housed individually (e.g., Lattal & Gleeson, 1990; Schlinger & Blakely, 1994). The dogs used in this study were recruited from amongst the pet dog population. They often lived with multiple humans and sometimes with conspecifics as well. It is possible that general species differences and the contrast in subjects' backgrounds may have had some impact on the outcomes; using laboratory dogs may produce different results.

A level of reinforcer deprivation is standard practice in laboratory-based operant animal research – it is a motivating operation procedure that increases the reinforcing effectiveness of the food (or the chosen reinforcer; Pierce & Cheney, 2013). Most comparable delayed reinforcement studies deprived their subjects of the reinforcer to a considerable degree relative to the current study. For example, the rats and pigeons in the experiments by Lattal and Gleeson (1990) were kept at just 70% of their free-feeding body weight. According to the authors, this "insured a vigorous approach to the food source and a strong level of activity, which seems important in developing behaviour under delayed reinforcement conditions" (Lattal & Gleeson, 1990, p. 37). It is conceivable that the dogs in the present study may have been more motivated to explore their surroundings, particularly the

food-scented boxes, had they been food deprived for longer (the average fast time was approximately six hours). However, the experimental procedure itself ensured that if the dogs were not sufficiently motivated to consume the food during the pre-experiment training then this led to them being withdrawn from the study (and the small amount of food received in the pre-experiment training was unlikely to have affected the dogs' motivation), so this is unlikely to have affected the results. In addition, everyday dog training frequently takes place at various times throughout the day (although sometimes meals may be delayed prior to training sessions), and therefore a short period of food deprivation does reflect many dog training practices in real life.

A possible influence on why some dogs did not learn the task could be the strength of the lures (the scented boxes) – they may not have been of sufficient strength for all dogs. In response to this, a slight variation on the procedure, with a stronger lure, was trialled prior to Condition 3. This is detailed in Appendix C. The results of this pilot study indicated that an altered lure strength may have influenced some dogs' behaviour, but no changes were made to the methods for the sake of consistency. This may be worth investigating in future research.

Dogs who did not learn in the 1 s delay or signalled delay conditions were switched to the immediate reinforcement condition and 40.00% and 58.33% (respectively) of them then learned the task. The discrepancies between these numbers may be explained by extinction and conditioned reinforcement. Dogs from the 1 s delay group had previously received little reinforcement for exploratory behaviour, and thus that tendency could have been extinguished on another experimental day. Dogs in the signalled condition did receive some immediate (albeit conditioned) feedback, and thus this may have aided a higher

rate of task acquisition once these dogs moved into the immediate reinforcement condition.

Fifty one of the 111 dogs originally recruited for the full study were withdrawn, some due to apparent distress at separation from their owners and/or the (apparent) social isolation whilst being in the experimental pen. This was despite the attempts to make the dogs feel comfortable at the training facility. Because so many dogs were withdrawn, this sample of dogs may not be representative of the pet dog population in New Zealand. There is evidence of dogs showing attachment to their owners in a manner similar to child-mother and chimpanzee-human attachment (Mariti, Ricci, Zilocchi, & Gazzano, 2013). Dogs' attachment to their owners may be relevant to their problem-solving abilities in that a strong level of attachment may result in reduced persistence at tasks and exploratory behaviour in the absence of their owners (Horn, Huber, & Range, 2013; Palmer & Custance, 2008). Conducting this study at the owners' homes or having the owners present in the experimental room may have reduced the potential for some dogs to feel distressed. However, the dogs were required to stay at the facility for several hours each experimental day, many dogs returned on at least two occasions, and the environment at the training facility was not particularly comfortable for humans; these factors combined to make it unlikely that many owners would be willing to stay with their dogs for the necessary periods of time. Also, the goal was to avoid any extraneous stimuli during the experiments that might have affected dogs' learning, and thus the decision was made to conduct the experiments in a controlled laboratory setting. For these reasons, owners left their dogs at the training facility for this study.

Summary

This study shows that short delays to positive reinforcement can affect how readily dogs learn a novel task, indicating that timing of reinforcement is an important variable in successful dog training. Delays of just 1 s decreased the proportion of dogs who were able to learn the experimental task. A previous study in this thesis (Chapter 3) showed that owners do deliver positive reinforcement at a wide range of delays in real-life dog training. Therefore the current results have direct implications for dog training, suggesting that if owners delivered reinforcement (consistently) faster, training would be more efficacious. This then leads to the question: if delayed reinforcement is common and it can be detrimental to dogs' learning, how do dogs learn new behaviours in real life? This question is investigated in Chapter 5. Due to factors regarding dogs' attachment to their owners, the next study was conducted in the dogs' own home environments with their owners conducting the training exercises.

CHAPTER 5: OBSERVATIONS OF DOG OWNERS' BODY LANGUAGE

Introduction

Effective and efficient dog training is important in avoiding and/or reducing problem behaviours, as well as maintaining good human-dog relationships. Enabling dogs to successfully learn new tasks is an important component of this. The results from Chapter 4 showed that short delays to positive reinforcement in experimental conditions can have a negative effect on dogs' ability to learn a novel task. The observations presented in Chapter 3 revealed that in real-life dog training, owners deliver positive reinforcement with a wide range of delays. However, despite the fact that delayed reinforcement is both detrimental in terms of learning, and common in real-life situations, dogs do learn new behaviours in everyday training. Granted, this training may not be as successful as would be ideal; for example, the dogs observed in the study in Chapter 3 did not respond in any way to 44.20% of commands. But nevertheless, some learning does take place.

A factor that may aid dogs' learning despite delayed reinforcement, is the body language displayed by people during training. Dogs are very receptive to human communicative cues such as hand signals and body orientation (Soproni et al., 2002; Virányi et al., 2004; as described in Chapter 1). The results in Chapter 2 showed that dog owners and trainers believe such cues are important during dog training, and the use of these cues is advocated in some popular literature. Owner-given reinforcement was measured in Chapter 3, but it was acknowledged that there may have been subtle cues given that were not measured. It is possible that owners may provide their dogs with unintentional signals, such as reaching

towards their pocket for food or altering their body posture, immediately after their dogs perform a response but before they intentionally deliver positive reinforcement. Because dogs are receptive to human body language, these unintentional cues may provide more information to dogs than their owners realise – even acting as conditioned reinforcement prior to the delayed intentional reinforcement. The possibility of this has been raised elsewhere as well (Martin & Friedman, 2011; Smith & Davis, 2008; Williams et al., 2004) but there is no known published data on this. When positive reinforcement is delayed experimentally but preceded by an immediate signal, these signals can function as conditioned reinforcers (Lattal, 2010). In operant experiments, rats receiving signalled delays will acquire stable responding more rapidly, and their response rates will continue to increase more, compared to animals exposed to the same delays without a signal (Critchfield & Lattal, 1993; Schlinger & Blakely, 1994; see Chapter 4). This was also examined in the experiment presented in Chapter 4, where a signalled delay had some effect on dogs' learning. More dogs who experienced a signalled delay to positive reinforcement learned the task than those who received an unsignalled delay, although the largest number of dogs who learned were in the group that received immediate reinforcement. Based on this information, the idea that owners may provide unintentional conditioned reinforcement to their dogs prior to intentional feedback (which is sometimes delayed) is worth investigating.

The aim of this study was to examine the order and timing of owners' actions after dogs have made target responses during a training task. Given the difficulty in recruiting dogs suited to working in a laboratory environment as previously described in Chapter 4, this study was carried out in naturalistic

training situations, in locations of the owners' choosing. The owners trained their dogs to perform novel behaviours, and the timing of owners' feedback was examined. The hypothesis was that dog owners give physical cues immediately after their dogs perform a response, which may bridge the time gap between the dogs' responses and the owners' intentional feedback.

Method

An informal pilot study was conducted via review of videos from the observational study in Chapter 3, as well as casual observations of dog training. This was done to determine the measures used in the scoring of this study (see *Measures*, below).

Participants

Participants were recruited in the same manner as in Chapter 4: via advertising and word of mouth. Twenty two dog owners/handlers and their dogs initially participated in this research; one dog failed to reach the inclusion criteria (described in *Design* below) and so was withdrawn from the study. The remaining 21 owners were a median age of 33.5 years, ranging from 18 to 80 years (Table 5.1). Seventeen of the owners were female and four were male; and they had a range of dog ownership and training experience (Table 5.1).

Twenty dogs were trained by the owners in this study (one dog was trained by two people; Table 5.2). There were eight females and 12 dogs, ranging in age from six months to 10 years, with a median age of 4.5 years. The dogs were a variety of breeds (Table 5.2).

Approval for this study was gained from the University of Waikato School of Psychology Research and Ethics Committee (protocol number 09:20); and from

Table 5.1

Owners' Demographic, Dog Ownership, and Training Experience Information

Owner	Age (years)	Gender	Ethnicity	Number of dogs owned in lifetime	Period of dog ownership in lifetime (years)	Level of obedience training attained (with any dog)
5.1	21	Female	NZ European	4	10	Novice championship
5.2	22	Female	English	4	20	Puppy classes
5.3	39	Female	NZ European	4	20	Puppy classes
5.4	33	Female	NZ European	2	2	Beginner
5.5	50	Female	NZ European	Unspecified	Unspecified	Beginner
5.6	50	Male	NZ European	8	38	Some, but unspecified
5.7	60	Female	NZ European	5	35	Some, but unspecified
5.8	32	Female	NZ European	1	4	Intermediate
5.9	Unspecified	Female	NZ Indian	2	2.5	N/A
5.10	44	Female	NZ European	2	5	Beginner
5.11	34	Female	Hungarian	3	14	Intermediate
5.12	50	Male	NZ European	7	40	N/A
5.13	55	Female	NZ European	2	18	Beginner
5.14	25	Female	NZ European	4	17	N/A
5.15	23	Female	NZ European	1	0.2	N/A
5.16	19	Male	NZ European	1	8	N/A
5.17	19	Male	NZ European	3	3	N/A
5.18	42	Female	Caucasian	4	30	Beginner
5.19	19	Female	NZ European	5	10	Some, but unspecified
5.20	18	Female	NZ European	4	7	N/A
5.21	80	Female	European	1	4	N/A

Table 5.2

Details of the Dogs Who Participated in This Study

Dog	Age (years)	Sex	Breed
Volt	6.5	Female[s]	Border collie cross
Bovril	7	Male[n]	Labrador retriever x spaniel
Beau	3	Male[n]	Maltese x miniature poodle
Pebbles	3	Female[s]	Labrador retriever x huntaway
Jaffa	0.5	Female	Labrador retriever
Fynne	6.5	Male	Labrador retriever
Robbie	1	Male[n]	Labrador retriever x Staffordshire terrier
Baxter	4.5	Male[n]	Miniature schnauzer
Pippi	2.5	Male[n]	Chihuahua x papillon x poodle
Shiloh	0.5	Female	Labrador retriever x huntaway
Eper	4	Male[n]	Hungarian puli
Elmo	9	Male	Huntaway x German shepherd
Moses	10	Male[n]	Labrador retriever x huntaway
Shadow	6	Male[n]	Greyhound
Snozz	3	Male[n]	Greyhound
Ayra*	7.5	Female[s]	Labrador retriever
Grace	7	Female[s]	Golden retriever
Tessie	6.5	Female[s]	Bearded collie cross
Murphy	4	Male[n]	Shih tzu cross
Sasha	4.5	Female[s]	Rottweiler x huntaway

[s]Spayed, [n]neutered.

*This dog was trained by two different people.

the University of Waikato Animal Ethics Committee (protocol number 910). Prior to the commencement of this study, all of the owners were given an information sheet describing the background of the project, had the opportunity to ask questions of the researcher, and were asked to sign a consent form. Owners who were students in an undergraduate psychology course were given 1% course credit for participating in this study.

Inclusion criteria. The criteria for being included in this study were that the dogs were willing to interact with the apparatus and they were motivated to work for food. One dog appeared frightened by all of the apparatus and would not

eat any food; the training session was terminated for this dog and it was withdrawn from the study. No data are presented for this owner-dog dyad.

Study Location and Apparatus

This study was conducted at the dog owners' homes for the majority of owners. Two owners, 5.19 and 5.20, opted to do the training elsewhere (the University of Waikato grounds, and a public park, respectively). The training exercises were conducted indoors or outdoors depending on the owners' preference.

The apparatus included a wand (a height-adjustable, telescopic pole with a foam ball on one end, connected to a weighted, self-righting base), a small (45 x 56 cm) carpet mat, and a plastic step stool. The researcher provided owners with a bag of cubed commercial dog roll, Possyum, to use during the training (or they were free to use their own treats if they preferred). One owner (5.7) provided their own clicker. A video camera (Panasonic® HC-V100) was mounted on a tripod and operated by the researcher to film interactions between the owners and their dogs.

Design

The owners were required to train their dogs to perform one of three tasks: nose-touch the top of the wand, place two feet on the mat, or place two feet on top of the step stool; all whilst being filmed. The tasks were always trained in this order; if any of the dogs were familiar with the first task then the training started with the second task, and so on. If the owners issued other commands that resulted in responses with clearly defined finish points, e.g., sit, during the session then these were recorded and analysed for timing data also.

The training sessions lasted a maximum of 10 minutes, but could be stopped sooner if the owners requested. If an owner judged that their dog had learned one task and there was still time remaining in the session, or if they felt they were making no progress with a particular training task, then they moved on to the next task.

Video Analysis. The video footage was analysed for three types of events after a command or prompt had been given by owners: dogs' responses, owners' body movements immediately following dogs' responses, and positive reinforcement delivered intentionally by the owners. The order of these events was recorded, and the times between them were measured. Each response – body movement – reinforcement sequence was considered to be one trial. Adobe® Premier® Pro video editing software was used for this analysis and the analysis procedure was identical that to that described previously in Chapter 3.

Measures. A dog was considered to have made a response when they contacted the top of the wand with their nose or face, if they placed two paws on the mat, or if they placed two feet on top of the step stool, depending on the task. Times between these events and subsequent events were measured from the instant of the dog making bodily contact with the apparatus (or from the instant of contact with the second foot for the latter two tasks). If the dogs were commanded to sit or lie down, the definitions of dogs' responses were the same as those used in Chapter 3, as were the points used for time measurements.

Measurements of the owners' body movements were limited to those clearly observable from watching the video footage; this necessarily excluded very subtle cues such as eye movements, as per Braem and Mills (2010). There were three measures of post-response body movements (Table 5.3). Hand

Table 5.3

Ethogram of the Owners' Body Movements as Measured in This Study

Behaviour	Description
Hand movement (hand containing food)	A person moves their hand, which already contains food, towards a dog and delivers the food to the dog's mouth.
Hand movement (retrieving food)	A person moves their hand towards a food storage location (e.g., pocket or pouch), retrieves some food, and then moves their hand (now containing the food) towards a dog and delivers the food to the dog's mouth.
Posture change	When a person moves so that their overall body position changes. For example, when a crouching person moves their body upwards and they re-position themselves so they are standing; or a person who was bent forward at the waist moves their head and shoulders backward and upwards so that they are standing upright.

movements were measured from the point at which a hand, already containing food when a dog responded, began to move towards a dog to deliver the treat; or, if the food was held in a pocket or pouch then the hand movement was measured from the instant at which the owner began to retrieve the food for delivery. For changes in bodily posture (e.g., from in a crouch to standing up), then the time measurement was taken from the point at which a change in posture could be observed.

Positive reinforcement was deemed to be the delivery of auditory feedback (e.g., verbal praise such as "good dog" or the use of a clicker), patting, and food treats. Timing measurements for these events were the same as used in Chapter 3: starting points for them were the beginning of the word or sound, when an owner's hand made contact with a dog's body, and when the food was placed immediately in front of a dog's mouth, respectively.

Certain trials were not analysed, including those that were ambiguous (i.e., events without clear start or finish points), or concealed from view (e.g., when a

dog obscured the wand). Instances in which owners commanded or prompted but their dogs did not respond, when owners gave feedback prior to dogs' responses, and sequences that did not finish with the delivery of positive reinforcement, were also excluded from analysis.

Because the goal of this study was to examine owners' feedback, rather than whether they could teach their dogs the task or their dogs' responses, no measures of dogs' learning were made.

Procedure

Upon arrival at the owners' home (or selected training location), time was allowed for the dogs to familiarise themselves with the researcher, and for the researcher to explain the procedure to the owners. Owners were given instructions on how to proceed, which included the distance at which they should stand from the camera (approximately 5 m), not to whisper when speaking to their dogs, to try and stand with themselves and their dog in a line perpendicular to the camera (to best aid video capture of relevant communicative cues), and to keep the wand or other training apparatus visible to the camera wherever possible. In addition to this, the owners were asked to train their dogs however they would normally when attempting to teach their dog a new task. No further instructions were given on how to conduct the training, except if the owner was having significant difficulty, in which case it was suggested (in lay terms) that they could trying luring or shaping.

When owners and their dogs were ready to begin the training session, the researcher began recording with the video camera. No dogs were familiar with all three tasks, and all owners began with the nose-touching task except for the second person (5.17) training the dog Ayra, as this dog was already familiar with

this activity. If owners asked for advice during the training session only very limited suggestions were provided, such as some information on basic shaping or luring techniques.

Data Analysis

Because the training tasks themselves were not important (they were simply a way of getting owners to train their dogs to perform a novel task), and the focus of this study was the owners' feedback, the data from the dogs' responses were pooled across all of the different tasks. The data were summarised using descriptive statistics, including calculating the order of events following dogs' responses. The times between the events comprising trial were graphed for each dog using SigmaPlot (version 12.5). The overall average times between events were calculated.

Twenty five percent of trials, including at least one trial from each owner-dog dyad, were selected randomly to test for inter-observer reliability. An independent observer was trained to analyse the data as described previously. A Pearson's correlation was performed on this data, and reliability was accepted at 85% agreement (as per Smith & Davis, 2007). Seventy four trials and the events within them were reanalysed. Inter-observer reliability was very strong ($r(257) = 1.00$, $p < .001$), showing excellent agreement.

Results

Positive reinforcement was delivered to the dogs in 758 trials; of these, a total of 287 trials were suitable for analysis across the 21 owner-dog dyads. A distinct body movement made by the owners was the first feedback to follow the dogs' responses in 75.26% (216/287) of these trials (Table 5.4). Intentional positive reinforcement (e.g., auditory feedback such as verbal praise or a click,

Table 5.4

The Number of Trials in Which Different Types of Feedback Immediately Followed Dogs' Responses During a 10 Minute Training Session

Owners	First type of post-response feedback			Total trials
	Body movement	Positive reinforcement	Concurrent body movement and positive reinforcement	
5.1	22 (75.86%)	7 (24.14%)	0	29
5.2	12 (100%)	0	0	12
5.3	5 (100%)	0	0	5
5.4	13 (61.90%)	5 (23.81%)	3 (14.29%)	21
5.5	4 (57.14%)	3 (42.86%)	0	7
5.6	18 (90.00%)	2 (10.00%)	0	20
5.7	2 (16.67%)	10 (83.33%)	0	12
5.8	16 (69.56%)	6 (26.09%)	1 (4.35%)	23
5.9	2 (66.67%)	1 (33.33%)	0	3
5.10	13 (100%)	0	0	13
5.11	23 (100%)	0	0	23
5.12	1 (50.00%)	1 (50.00%)	0	2
5.13	5 (50.00%)	4 (40.00%)	1 (10.00%)	10
5.14	17 (73.91%)	4 (17.39%)	2 (8.70%)	23
5.15	20 (100%)	0	0	20
5.16	5 (55.56%)	3 (33.33%)	1 (11.11%)	9
5.17	1 (100%)	0	0	1
5.18	5 (62.50%)	3 (37.50%)	0	8
5.19	17 (60.72%)	9 (32.14%)	2 (7.14%)	28
5.20	4 (57.14%)	3 (42.86%)	0	7
5.21	11 (100%)	0	0	11
Total	216 (75.26%)	61 (21.26%)	10 (3.48%)	287

Note. Positive reinforcement includes auditory feedback (e.g., verbal praise or the use of a clicker), patting, and food treats.

and food) immediately followed the dogs' responses in 21.26% (61/287) trials. A body movement was made at the same time intentional feedback was delivered in 3.48% (10/287) of the trials. Some individual variation in this order of events was observed across owners (Table 5.4). The criteria used for a dog having made a response did not include reinforcement of successive approximations of the final target behaviour (because such movements were not able to be defined clearly for measurement); this may have led to the exclusion of some data. However, casual observations suggested that few approximations were reinforced in any systematic way.

Most of the owners gave their dogs several modes of feedback during the training. A representative example of the types and order of owner-given feedback is presented in Figure 5.1 (Appendix D contains the figures for all other owner-dog dyads). The most common order of events within a trial was for a dog to perform a response, followed by an owner's body movement, then auditory feedback (normally verbal praise) was given, and then finally a food treat was delivered. This occurred in 53.66% (154/287) of trials. The second most frequent order of events was a dog's response, then auditory feedback, the owner's body movement, and then food. This took place in 14.29% (41/287) of the trials. In 10.80% (31/287) of the trials the order of the events was a dog's response, then the owner's body movement, then food, and finally auditory reinforcement. The 61 (21.26%) remaining trials comprised of various orders of events (e.g., a dog's response, then owner's body movement, then food only; or auditory reinforcement and food being delivered at the same time following a body movement).

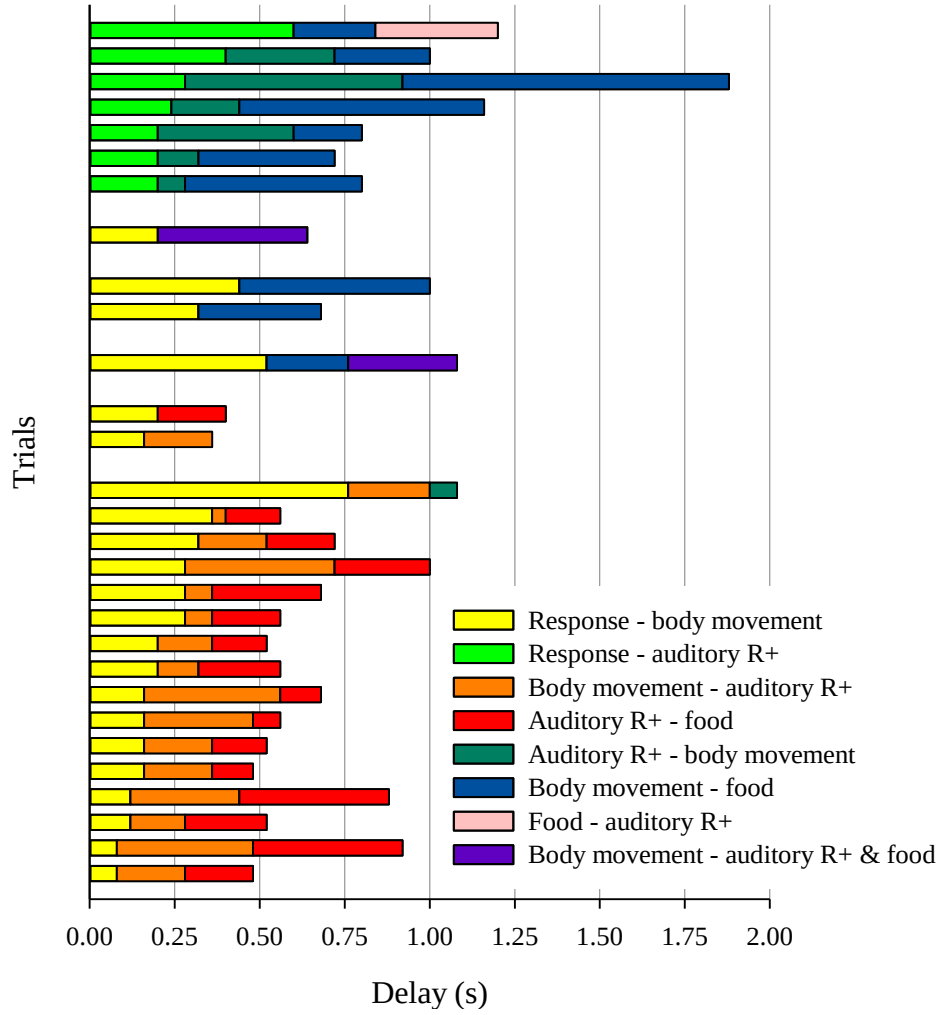

Figure 5.1. Feedback given by Owner 5.1 following Volt's responses (at time = 0 s) during a 10 minute training session. Different types of feedback are given at varying times and in differing orders across trials (N = 29). Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

Unconditioned reinforcement (e.g., food) was delivered in most trials. When body movements were the first form of feedback following dogs' responses, food was delivered in 93.52% (202/216) of these trials. When auditory reinforcement was the first post-response feedback, 68.85% (42/61) of these trials included food delivery.

There was variation across owners in terms of their latency to deliver the first instance of feedback to their dogs, be it body movement (in the majority of instances) or other types of feedback (Figure 5.2). In the 75.26% (216/287) of trials in which owners' body movements were the first form of feedback communicated to the dogs, the average delay between the dogs' responses and their owners' body movements was 0.31 s. When considering the most common sequence of events within trials (as described above, in the 154 trials), across all 21 owners the average delay between dogs' responses and owners' body movements was 0.32 s. Owners then took an additional average of 0.24 s to provide auditory reinforcement, and food was delivered after a further 0.83 s on average. The total average time taken for this sequence of events to complete (i.e., when these trials terminated with food delivery) was 1.40 s.

The body movement that most frequently followed the dogs' responses was hand movements, occurring in 82.23% (236/287) of trials across all owner-dog dyads (Table 5.5). A change in body position, standing upright from a bent-over position, was observed in 8.71% (25/287) of trials. Concurrent movement of both an owner's hand and their overall body position was measured in 5.58% (16/287) of trials. No observable body movement by owners followed dogs' responses in 3.48% (10/287) of the trials.

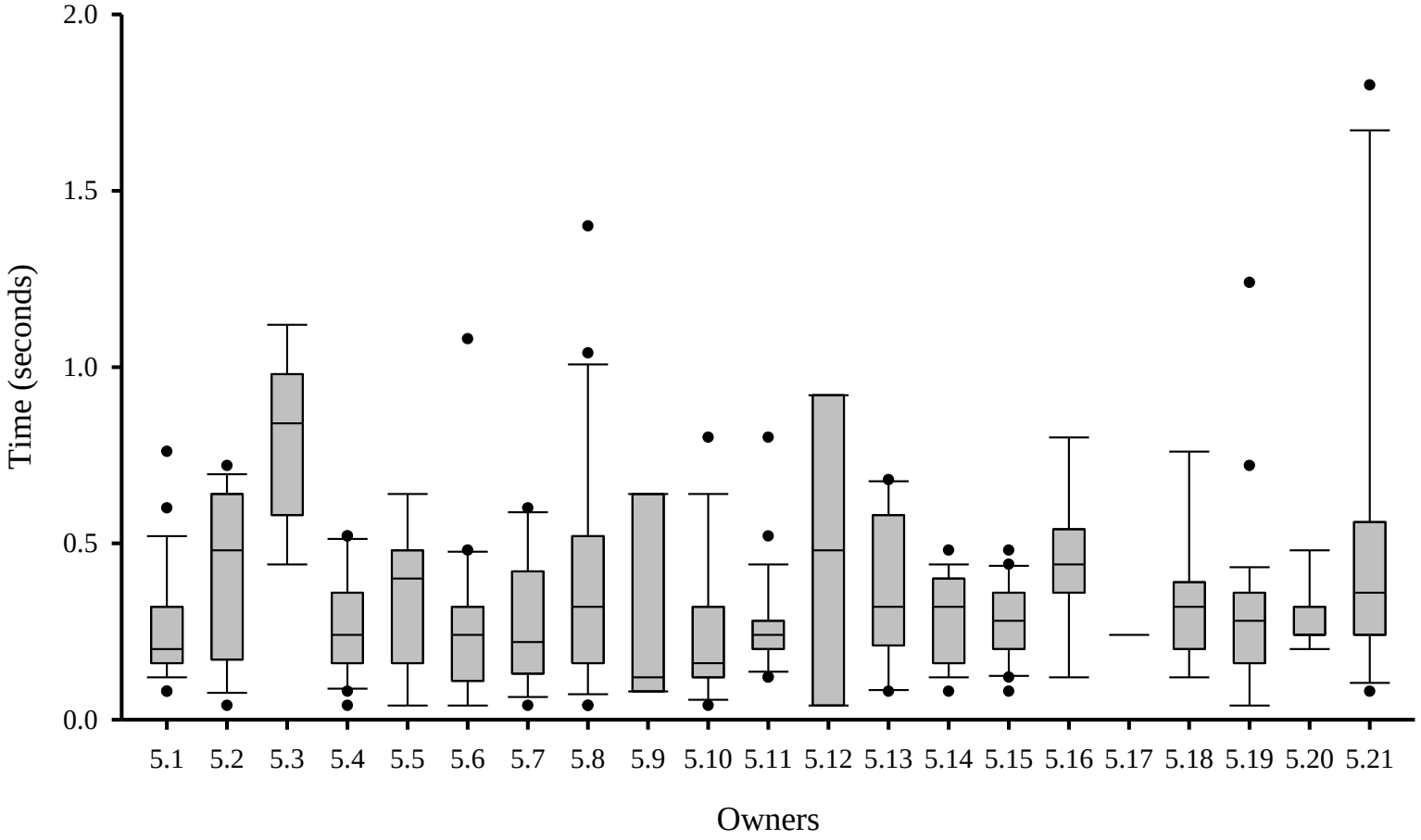

Figure 5.2. Variation in owners' delays to deliver the first instance of feedback to their dogs. Boxes represent 25th, 50th and 75th quartiles; whiskers represent 10th and 90th percentiles. Outliers are indicated by dots.

Table 5.5

The Number of Trials in Which Owners Made a Body Movement Immediately Following Their Dogs' Responses During a 10 Minute Training Session, Including The Type of Movements Observed

Owners	Type of body movement				Total trials
	Hand movement	Change in body position	Concurrent hand movement and change in body position	No body movement	
5.1	29 (100%)	0	0	0	29
5.2	12 (100%)	0	0	0	12
5.3	5 (100%)	0	0	0	5
5.4	20 (95.24%)	0	0	1 (4.76%)	21
5.5	6 (85.71%)	0	0	1 (14.29%)	7
5.6	15 (75.00%)	4 (20.00%)	1 (5.00%)	0	20
5.7	9 (75.00%)	2 (16.67%)	0	7 (8.33%)	12
5.8	17 (73.91%)	2 (8.70%)	1 (4.35%)	3 (13.04%)	23
5.9	2 (66.67%)	0	0	1 (33.33%)	3
5.10	13 (100%)	0	0	0	13
5.11	6 (26.09%)	7 (30.43%)	10 (43.48%)	0	23
5.12	1 (50.00%)	0	0	1 (50.00%)	2
5.13	8 (80.00%)	1 (10.00%)	0	1 (10.00%)	10
5.14	22 (95.65%)	1 (4.35%)	0	0	23
5.15	20 (100%)	0	0	0	20
5.16	8 (88.89%)	1 (11.11%)	0	0	9
5.17	1 (100%)	0	0	0	1
5.18	6 (75.00%)	1 (12.50%)	1 (12.50%)	0	8
5.19	24 (85.71%)	1 (3.57%)	2 (7.14%)	1 (3.57%)	28
5.20	7 (100%)	0	0	0	7
5.21	5 (45.45%)	5 (45.45%)	1 (9.10%)	0	11
Total	236 (82.23%)	25 (8.71%)	16 (5.58%)	10 (3.48%)	287

Discussion

The dog owners observed training their dogs in this study consistently provided feedback to the dogs in the form of body movements before any form of intentional feedback was delivered. These results support the initial hypothesis that physical cues given by dog owners bridge the temporal gap between dogs' responses and owners' deliberately delivered positive reinforcement.

In the most common sequence of events it took an average of 1.40 s for food to be delivered to dogs; this is longer than the 1 s delays shown to impede some dogs' learning in the Chapter 4 experiments. However, owners in this study gave physical cues as the first form of post-response feedback in the majority (75.26%) of the training trials, and the average delay between dogs' responses and owners' body movements (regardless of the subsequent feedback) was only 0.31 s. Because these cues were consistently delivered before any intentional feedback (e.g., verbal praise or food), and the form of the cues was relatively uniform (i.e., predominantly hand signals), they likely became highly salient during the training sessions. Given both the reliability and the immediacy of owners' body movements observed in this study, these results give support to the idea that this feedback could function as (probably) unintentional conditioned reinforcement. Dogs' attentiveness to body language (e.g., Miklósi et al., 1998) suggests such communicative cues could indeed function in this way. Despite intentionally delivered positive reinforcement being delayed commonly and to varying extents in real-life dog training situations (see Chapter 3), and the fact that delayed reinforcement can hinder dogs' learning (as shown in Chapter 4), the results from this study suggest that dogs' learning is aided by the rapid and reasonably

consistent feedback provided by owners' physical cues. No change in owners' delays over time was discerned from visual inspection of their graphed data.

In order for owners to deliver a food treat to a dog manually, some sort of body movement is necessarily made. For this reason, body movements almost always precede the delivery of a food treat to a dog's mouth in training situations such as in this study. When body movements were the first form of post-response feedback, food was delivered to the dogs more frequently (in 93.52% of trials) than in trials when auditory reinforcement was the first instance of feedback (68.85%). Because body movements (as first feedback) more reliably predicted the delivery of unconditioned reinforcement, the association between these cues and the food may be stronger than the association between the auditory feedback and food. In addition to body movements functioning as conditioned reinforcers via an operant conditioning mechanism, because body movements reliably predicted the delivery of food this is likely also to result in a classically conditioned association, with body movements functioning as conditioned stimuli. It is worth considering that in addition to the observable body movements measured in the current study, there may also be other human-given cues (e.g., physiological responses) that dogs are receptive to, which were unable to be measured using this methodology.

Two naturalistic training studies comparing the outcomes of immediately-delivered conditioned reinforcement (clicks) and manually delayed unconditioned reinforcement (food), versus delayed unconditioned reinforcement only, with dogs (Smith & Davis, 2008; approximately 1 s delays) and horses (Williams et al., 2004; approximately 5 s delays), have been described previously in Chapter 1. Both of these studies showed that no learning advantage was conferred when

clickers were used; however, both studies delivered food to the animals by hand. Such delivery necessitated some body movement prior to the animals receiving the food, which the authors acknowledged may have provided a source of conditioned reinforcement for the animals receiving delayed unconditioned reinforcement only. This could account for the conditioned reinforcement having no obvious impact in these naturalistic studies, whereas under more controlled laboratory conditions where unintentional feedback can be better controlled, signalled delays have been shown to aid rats' learning in comparison to the same, unsignalled delays (Critchfield & Lattal, 1993; Schlinger & Blakely, 1994) (although species differences across these studies should be acknowledged, as well as other methodological differences including the types of task being trained).

The current study was successful in terms of participant retention (particularly when compared to the attrition detailed in Chapter 4), which is largely attributable to aspects of the methodology. Working in environments with which the dogs were largely familiar reduced the need for habituation time; and it also reduced the potential for distractions during the training tasks as there were fewer novel stimuli in the environment. Having the owners conduct the training exercises not only provided the opportunity for examination of those owners' actions, but it also ensured the presence of a person with whom the dog was familiar and to whom the dog was attached (e.g., Mariti et al., 2013), thereby reducing the chance of the dogs experiencing stress during this study. Only one dog was withdrawn from this study, and no noteworthy signs of stress were observed in any of the other dogs recruited.

This research examined the human communicative factors that may contribute towards dogs' abilities to learn novel tasks with delayed positive reinforcement. It was found that physical cues were given consistently by owners as the first form of feedback after dogs had performed target responses. These rapidly-delivered cues likely functioned as conditioned reinforcement for the dogs, facilitating their learning in situations that might have otherwise been less than ideal training conditions in terms of temporal contiguity and operant learning. This study's setting was designed to replicate ordinary dog training situations, and thus the results of this study are likely to be applicable to everyday dog training.

CHAPTER 6: GENERAL DISCUSSION

The overall aim of this thesis was to explore the topic of human-dog communication and how this may affect the efficacy of dog training, with a particular focus on the timing of positive reinforcement.

The first two studies focused on dog training information (Chapter 2). The initial scoping study involved interviews with dog owners and trainers, and aimed to assess the importance they placed on sources of dog training information and the use of various human-given cues during training. Highly-ranked sources included personal experiences and books, as well as free sources (e.g., the Internet); tone of voice, eye contact, and hand gestures were the cues they perceived being of most value. The limitations of this study included question type and sample size. The goal of the second study was to examine the contents of five popular dog training books in comparison to academic literature. The results of this study showed that there were inconsistencies in the accuracy and level of detail provided across all of the books, and that some of the methods that were advocated may not be advisable from the perspectives of owner safety and animal welfare.

The books reviewed in Chapter 2 all referred (to varying extents) to human-given communication, including the timing of feedback such as positive reinforcement. Therefore, the aim of the third study (Chapter 3) was to observe owners training their dogs to establish the types of owner-dog interactions that take place during everyday dog training, with particular attention paid to the delivery of positive reinforcement. This study found that dogs obeyed commands

correctly approximately half of the time only, and that owners provided positive reinforcement to their dogs at a range of delays.

The next study (Chapter 4) aimed to investigate what impacts delayed reinforcement, such as that observed in everyday dog training, might have on dogs' learning. This was done under experimental conditions. Short delays to positive reinforcement resulted in fewer dogs learning a novel task compared to when dogs received immediate reinforcement.

The fact that the delays used in the delayed reinforcement experiment resulted in lower rates of learning, and yet similar delays were observed in the prior field study, lead to the fifth and final study of this thesis (Chapter 5). The goal of this study was to examine the feedback given by owners to dogs during training. The results showed that owners were providing physical cues (e.g., hand signals) before any intentional reinforcement was delivered – thus these cues may bridge the delay to reinforcement and likely function as conditioned reinforcement.

Major Findings

The main findings of this thesis are that the delayed delivery of positive reinforcement is a common occurrence during everyday dog training, but also that delays are detrimental to dogs' learning. However, it seems that human-given communicative cues bridge the temporal gap between dogs' responses and intentional owner-delivered reinforcement, thereby likely facilitating learning via a conditioned reinforcement mechanism.

Observations of dog owners training their dogs in naturalistic settings revealed that positive reinforcement is delivered at a range of delays. Experimental delays to positive reinforcement, using delays of a length similar to

those observed in the field study, resulted in fewer dogs learning a novel task as compared to dogs receiving immediate reinforcement. An intermediate number of dogs learned the same task with signalled delayed reinforcement (i.e., conditioned and unconditioned reinforcement). This experimentally delayed reinforcement also impacted negatively on how quickly dogs learned the task and their response rates. Despite the delays being relatively short in length, the effects of delayed reinforcement are comparable to those demonstrated in other empirical research with different species (e.g., Dickinson et al., 1992; Lattal & Gleeson, 1990; Schlinger & Blakely, 1994). The fact that the dogs seemed to be less tolerant to delayed reinforcement compared to other species may be explained by factors such as motivation, the higher number of sessions used in other operant studies, and species differences. Another aspect to delayed reinforcement is that the delays provide opportunities for dogs to perform other behaviours before the delivery of reinforcement. This could be problematic in terms of non-target behaviours (including unwanted ones) being reinforced accidently. Overall, these findings show that the efficacy of dog training is likely to be compromised by delayed positive reinforcement.

The experimental work in this thesis was conducted in laboratory conditions to allow greater control over the variables that could affect the dogs' learning. Investigating delayed reinforcement in this manner allowed examination of the effects of delays in isolation from other potential sources of feedback, and the results showed that delays do hinder dogs' learning in such circumstances. However, real-life dog training situations are complex: the environments are seldom free of distractions (e.g., scents), and trainers often present multi-model signals during training (Mills, 2005). The fact that delayed positive reinforcement

in controlled conditions interfered with dogs' learning, and yet these same delays are observed commonly in everyday training, provides further support for the idea that dogs are assimilating of a range of human-given feedback to aid their learning.

Given these results, it may be surprising that dogs learn under conditions such as those observed in the field. However, clearly dogs do learn in ordinary circumstances (although arguably not as efficaciously as they could). This could be explained by the finding that owners do provide their dogs with rapid feedback during training – albeit probably unintentionally – in the form of physical signals such as hand movements. Dog owners were observed giving physical cues prior to intentionally-delivered positive reinforcement, bridging the gap between the dogs' responses and the reinforcement. The possibility of human body movements providing feedback to animals during training been suggested anecdotally elsewhere (Martin & Friedman, 2011; Smith & Davis, 2008; Williams et al., 2004), but the current research is the first known confirmation of this. Providing unconditioned reinforcement such as food, rapidly, is difficult considering the motor movements involved. It is for this reason that training methods employing conditioned reinforcement, such as clickers, have been developed: to enable rapid reinforcement of target behaviours (Skinner, 1951). It is likely that human cues given during training function in this way. Intention on the owners' behalf to signal their dogs in this manner is not necessarily a requirement for these cues to function as conditioned reinforcement. The delays to these cues were short, the cues were delivered reliably and consistently, and they were normally associated with unconditioned reinforcement (Pierce & Cheney, 2013). In addition, these cues typically involved hand gestures leading to the delivery of food, and dogs are

known to be particularly receptive to this type of signal (Soproni et al., 2002). Taken together this suggests that these cues could function as conditioned reinforcers that aid dogs' learning when exposed to delayed positive reinforcement. This conclusion is further supported by operant research that shows rats learn novel tasks faster and respond at higher rates when provided with signalled, as compared to non-signalled, delayed reinforcement (Critchfield & Lattal, 1993; Schlinger & Blakely, 1994). Additionally, two naturalistic training experiments comparing the use and non-use of clickers with short delays to unconditioned reinforcement, failed to find that clickers improved dogs' or horses' learning (Smith & Davis, 2008; Williams et al., 2004). The authors contend that this may be because although the click provided immediate conditioned reinforcement, the hand-delivery of food in these applied studies required body movements that could have functioned as conditioned reinforcers – thus conditioned reinforcement was actually present in both non-/click conditions. These applied findings provide additional support for the idea that some other unintentional feedback is being provided during delays to account for all animals learning despite the delays. The significant correlation between longer average delays to reinforcement and higher relative obedience also indicates that another mode of owner-given feedback was likely involved in this training.

Not only is positive reinforcement delayed in everyday dog training – the fact that the dogs in the present research failed to respond to many (44.20%) of their owners' commands shows that there is room for improvement in the training methods being employed commonly. Granted, these owners were participants in beginners' classes, but equally they were willing to pay for dog training coaching, committed to spending up to 10 weeks attending these classes, and amenable to

being filmed whilst training their dogs; arguably these attributes demonstrate better-than-average commitment to their dogs' training and so perhaps a higher level of dog training proficiency accordingly. If this is the level of responding to commands seen within this sub-group of owners and their dogs, it is possible that obedience is even lower in the wider population.

One way to address poor training outcomes would be to provide owners with accurate dog training information. Some of the reviewed dog training books emphasised the importance of providing rapid feedback and using communicative cues during training. However, the advice provided in these books was of varying quality. These books are not necessarily a reliable source of best-practice information, despite owners and trainers in this research and other studies placing a lot of importance on books as a source of dog training information (Bennett & Rohlf, 2007; Shore et al., 2008). Given the results of the present research, pertinent advice to dog owners should include advocacy of rapid positive reinforcement, and an emphasis on providing consistent forms of feedback – including physical cues.

Strengths and Limitations

In order to gain a good understanding of factors that contribute to successful dog training, knowing what takes place during training is a necessary starting point. The field-based observations of owners training their dogs provided insight into this information, and allowed data collection from real-life dog training situations. It is acknowledged that the participants in this research were convenience samples and may represent a more engaged sector of the dog owning population. However, the fact that they were ordinary owners training their pet

dogs makes the findings of this research very applicable to everyday dog training; more so, for example, than if laboratory dogs or professional dog handlers had been used, which may have produced different results (e.g., Lazarowski & Dorman, 2015). Thus the findings from this research and the resulting recommendations are likely to be highly applicable in most dog training situations.

Real-life training scenarios and a laboratory-based experiment were used to approach this research topic. Using both methodological approaches is another strength of this research, as it enabled systematic investigation of the effects of delayed reinforcement on dogs' learning whilst maintaining an applied focus to this research.

The experimental study in this thesis was useful for examining the effects of delayed reinforcement on dogs' learning without the influence of other forms of feedback that are commonly present in dog training contexts. However, this work also highlighted the challenges of recruiting pet dogs suitable for working in laboratory conditions. There was a high rate of subject attrition for reasons such as the dogs showing persistent signs of distress, food failing to be reinforcing, or dogs behaving in a manner that risked equipment damage or otherwise jeopardised the success of future sessions (e.g., urinating in the experimental pen). This was a significant drawback due simply to the large amount of time involved in recruiting each dog. Not all pet dogs are used to going into new environments, and some dogs are highly attached to their owners (Mariti et al., 2013) and thus may find being separated from their owners stressful. Despite the researcher's best efforts at ameliorating potential stress, this clearly was an issue in this situation. Given this, the design of the subsequent study in this thesis was adjusted accordingly. Recommendations for future research in laboratory settings using pet

dogs include shorter experimental sessions with a design and environment that enables owners to be present during the testing.

Future Research

Directions for future research could include examining experienced and inexperienced dog trainers, and evaluating the types of feedback they give to dogs during training. It would be interesting to compare these two groups to see if there are measurable differences in the provision of variables such as physical cues, verbal feedback, and reinforcement delivery times. It would also be of value to investigate whether any observed differences were related to training success.

Although it is well-established that dogs are very responsive to human communicative cues, it is also understood that there is individual variation in dogs' responsiveness. This may be due to factors such as breed histories, physical differences (e.g., brachycephalic vs. dolichocephalic dogs), and learning histories (Gácsi et al., 2009a; Gácsi et al., 2009b; Udell et al., 2010; Wobber et al., 2009). Dogs typically looked at their owners during training, but an interesting extension to this research would be if an eye tracking procedure with dogs could be adapted for use in a training situation (e.g., Williams, Mills, & Guo, 2011), allowing confirmation of exactly what and when dogs are attending to (e.g., owners' hands, face) during training. It would be interesting to measure if any breed, physical, or learning differences between groups of dogs might affect their attentiveness to human-given cues.

In the experimental study, the free-operant response that the dogs were required to perform needed to be 'captured' via adventitious reinforcement initially; if the dogs did not persevere in investigating the target box then the

response was not able to be learned. Using a shaping procedure may have ensured more participation from the dogs. However, shaping requires reinforcement of successive approximations of the target behaviour, and it was not possible to devise a shaping procedure comprising standardised approximations for all dogs within the constraints of the experimental design and available equipment. Future research could investigate how to conduct a shaping procedure that can be implemented consistently across multiple dogs in a similar experimental procedure.

The effects of delayed positive reinforcement on the topography of dogs' behaviour is worthy of investigation. For example, it would be interesting to know if dogs who learned the experimental task with delayed reinforcement might hold their head in the target box for longer (waiting for the reinforcement to be delivered) than those dogs who received immediate reinforcement. Such information would be relevant to dog training activities in which precise movements are important, such as scent detection (indications) and competitive obedience.

Conclusions and Practical Implications of This Research

In conclusion, this research found that the type of feedback given to dogs by their owners can affect training outcomes. It was found that delayed positive reinforcement is both common during dog training and detrimental to dogs' learning. However, it was also demonstrated that owners do provide feedback rapidly and consistently in the form of physical cues, prior to intentionally-delivered positive reinforcement, and thus these cues likely function as conditioned reinforcement.

Based on these findings, advice to dog owners and trainers should emphasise the importance of delivering positive reinforcement to dogs quickly. It may be equally, or even more, useful, to encourage the use of physical cues such as hand signals during dog training. Dogs are receptive to such signals (e.g., Miklósi et al., 1998), and this research demonstrates that this mode of feedback is likely to be delivered more rapidly by owners than intentional positive reinforcement. However, the particular form of feedback that owners provide to their dogs may not be crucial. As long as this feedback is provided rapidly, consistently, and is regularly paired with unconditioned reinforcement (Pierce & Cheney, 2013), it is likely to meet the criteria for conditioned reinforcement and thus aid learning in delay situations – which we know now to be commonplace.

It is important that dog training is successful. It is known that the presence of undesirable behaviours is a major reason for dogs being surrendered to animal shelters (Diesel et al., 2010; Patronek et al., 1996; Wells & Hepper, 2000), and that there is a relationship between training and dogs displaying fewer problem behaviours (Arhant et al., 2010; Bennett & Rohlf, 2007; Jagoe & Serpell, 1996). The findings presented in this thesis highlight dogs' sensitivity to human-given signals in training situations, and thus this research has practical implications for the manner in which dogs are trained. Having an awareness of the impacts of delayed positive reinforcement, and therefore being able to take steps to avoid or mitigate the effects of these delays, is a valuable contribution to more efficacious dog training.

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APPENDIX A: INTERVIEW SCHEDULE

This appendix contains the interview schedule used for the dog owner and dog trainer interviews, presented in Chapter 2.

1. Person's demographic information:
   - **a.** Owner / Non-professional trainer / Professional trainer?
     _____
   - **b.** Sex (i.e., male or female)?
     _____
   - **c.** Age?
     _____
   - **d.** Ethnicity (i.e., NZ-European, Maori, etc.)?
     _____
   - **e.** Occupation?
     _____

2. How many dogs have you owned in your life?

_____

3. How many dogs do you own now?

_____

4. How many years in total have you owned dogs?

_____

5. Non-professional trainers: How many years' experience do you have training dogs at dog clubs?

_____

5. Professional trainers: How many years' experience do you have training dogs professionally?

_____

6. Describe all of the dogs you have previously owned:

- **a.** Sex (i.e., spayed female, entire male, etc.)? _____
- **b.** Age (at acquisition)? _____
- **c.** Breed? _____
- **d.** Kept indoors or outdoors? _____
- **e.** Attended obedience classes (# weeks)? _____
- **f.** Role of the dog (i.e., pet, hunting, competitive obedience, etc.)? _____

7. Describe the dog(s) you currently own:

- **a.** Sex (i.e., spayed female, entire male, etc.)? _____
- **b.** Age (at acquisition and currently)? _____
- **c.** Breed? _____
- **d.** Kept indoors or outdoors? _____
- **e.** Attended obedience classes (# weeks)? _____
- **f.** Role of the dog (i.e., pet, hunting, competitive obedience, etc.)? _____

The next few questions I'm going to ask you are trying to build a picture of how much time you spend with your dog and how much time you spend training them.

8. When considering your current dog, how often do you walk them?

_____

9. How often do you play with your dog?

_____

10. How often do you train your dog? This means deliberately setting aside time with the aim of teaching or re-teaching them something. (E.g., practising 'down' if they're not very good at it, or teaching 'shake', etc.)

_____

11. When you spend time with your dog doing things such as walking or playing (not in a specific training situation), how often do you use commands and make sure that the dog responds correctly? (E.g., making your dog sit before crossing the road, or making them drop a ball when you tell them to.)

_____

These questions are specifically about dog training.

12. How did you learn how to train dogs?

_____

_____

_____

13. Which of these things have you used to learn about dog training? (You may tick more than one box.)

Of the things you have used, please rank them from most important to least important.

	Have used (yes/no)	Ranking (most important = 1)
a. Puppy socialisation classes	☐	☐
b. Dog obedience classes	☐	☐
c. Other dog owners (casual discussion)	☐	☐
d. Other dog trainers (casual discussion)	☐	☐
e. Other dog trainers (professional consultation)	☐	☐
f. Personal experience (trial and error)	☐	☐
g. Books	☐	☐
h. Television shows	☐	☐
i. Videos	☐	☐
j. Internet websites	☐	☐
k. University study	☐	☐
l. Polytechnic study	☐	☐
m. Seminars and/or workshops given by professional dog trainers	☐	☐

14. When you consider communication between humans and dogs during dog training, what things do you think are important to achieving a successful outcome (i.e., the dog learning a task)?

_____

_____

_____

15. Which of these things do you think are important to achieving a successful training outcome (i.e., the dog learning a task)? (You may tick more than one box.)

Of the things you think are important, please rank them from most important to least important.

	Important (yes/no)	Ranking (most important = 1)
a. Eye contact	☐	☐
b. Trainer's head orientation	☐	☐
c. Trainer's body orientation	☐	☐
d. Proximity to the dog	☐	☐
e. Trainer's body position (standing, leaning, sitting or crouching)	☐	☐
f. Hand gestures	☐	☐
g. Arm movements	☐	☐
h. Tone of voice	☐	☐
i. Volume of voice	☐	☐
j. Pronouncing commands clearly	☐	☐
k. Trainer making sudden sounds (i.e., clapping)	☐	☐
l. Trainer making sudden movements (i.e., waving arms or running)	☐	☐

16. When you consider your answers for questions 14 and 15, why are these things important to successful dog training? (I.e., how do these things help achieve successful dog training?)

_____

_____

_____

17. Which aspects of a trainer's behaviour (as in questions 14 and 15) are important to achieving a successful outcome (i.e., the dog learning a task or obeying a command) in the following situations:

a. Doing maintenance training of a task a dog already knows? (I.e., practicing "come".)

_____

Why?

_____

b. Teaching a dog a new task?

_____

Why?

_____

c. Taking a dog to a new place for the first time?

_____

Why?

_____

d. When a dog is distracted by something? (I.e., another dog, food, noise, smells, etc.)

_____

Why?

_____

18. Are you willing to take part in future studies? Can I keep your contact details for this?

_____

If you have any questions about this interview or the research project, please use these contact details:

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APPENDIX B:

CHAPTER 4 PILOT STUDY 1 – METHODOLOGY DEVELOPMENT

Introduction

The purpose of this pilot study was to develop the procedure and equipment that was used in the research described in Chapter 4: experimental manipulation of delay reinforcement. The aim was to exploit dogs' natural tendency to explore a novel environment via olfactory means, and to use this to devise a protocol in which dogs could learn a novel task without shaping or conventional luring techniques.

Approval for this project was gained from the University of Waikato School of Psychology Research and Ethics Committee (protocol number 11/43), and from the University of Waikato Animal Ethics Committee (protocol number 846).

Method and Results

Five different experimental procedures were trialled in a total of 38 sessions in this pilot study. Positive reinforcement was delivered immediately to the dogs in all of the piloted procedures.

Subjects

Dogs were recruited for this pilot study from amongst the researcher's own dogs and word of mouth through contacts. Nineteen dogs were used: 11 females and eight males, ranging in age from 0.6 to 10 years of age, and of various breeds (Table B.1). Some dogs were used in more than one procedure (Table B.1), and some dogs participated in more than one session per procedure (Table B.2).

Table B.1

Details of the Dogs Who Participated in the Pilot Study

Subject	Age (years)	Sex	Breed	Procedure
Apple	10	Female[s]	German short-haired pointer x border collie	1, 2, 3
Flint	1.5	Male	Heading dog	1, 2, 3, 5
Kimchi	6	Female[s]	Papillion cross	2, 3
Benny	0.7	Male[n]	Bearded collie cross	2, 4
Lara	5.5	Female[s]	Labrador retriever	2
Ernie	8	Male[n]	Tibetan terrier	4
Jack-1	2.5	Male[n]	Wire-haired Jack Russell terrier	4
Tyson	1	Male[n]	Staffordshire terrier cross	4
Teagan	3	Female[s]	Collie cross	4
Jack-2	3	Male[n]	Fox terrier x spaniel	4
Abby	3	Female[s]	Collie cross	4
Lucy	9	Female[s]	Staffordshire bull terrier x Doberman pinscher	4
Jemma	5.5	Female	Labrador retriever	5
Charles	0.6	Male	Staffordshire bull terrier	5
Sasha	2.5	Female[s]	Huntaway x Rottweiler	5
Niia	4.5	Female[s]	German shepherd	5
Mishka	8.5	Female	Norwegian elk hound	5
Romsey	6	Male	Gordon setter	5
Rippley	0.75	Female[s]	Border collie x Polish lowland sheepdog	5

[s]Spayed, [n]neutered.

Table B.2

The Number of Responses Performed by Dogs in a Session in Each of the Five Pilot Study Procedures

Dogs	Procedure 1	Procedure 2	Procedure 3	Procedure 4	Procedure 5
Apple	1	21	3		
Flint	1	4, 8	19		179
Kimchi		46	1, 76		
Benny		129		6, 55	
Lara		3			
Ernie				3, 2	
Jack-1				1, 2, 0	
Tyson				3, 135	
Teagan				3, 0	
Jack-2				1, 0	
Abby				2, 0	
Lucy				1, 0	
Jemma					13, 76
Charles					105
Sasha					199
Niia					Unknown*
Mishka					196
Romsey					1
Rippley					109

Note. Some dogs participated in more than one session per procedure.

*This dog's data were lost due to a technical problem, but she responded approximately 200 times.

Study Location

This study was conducted at a training facility at the University of Waikato, Hamilton, New Zealand. This facility consisted of three rooms: an office, a small training room, and a second larger training room (Figure B.1).

Procedure 1

The aim of this procedure was for the dogs to learn to go to one corner of the room that contained an infrared beam. The dogs were trained to use a MannersMinder® electronic food dispenser prior to this procedure. This dispenser was activated by remote control and delivered food treats (kibble); the dogs

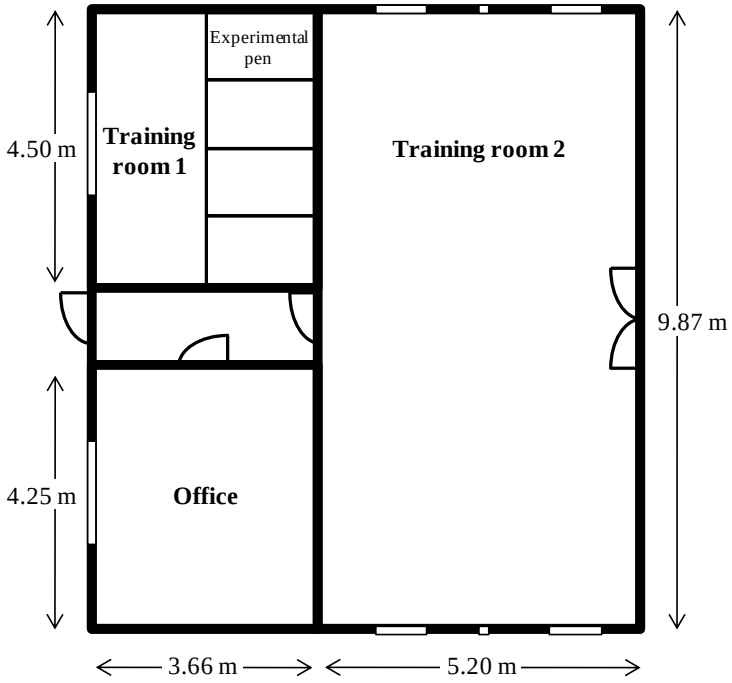

Figure B.1. Layout of the training facility where this study was carried out.

learned to associate the mechanical noise of it operating with food presentation. The experiment was initially set up in a section of the largest training room, and involved an infrared beam being projected across one corner of this area (Figure B.2). The MannersMinder® was placed in the corner of the room opposite to the infrared beam and used to deliver reinforcement (food) to the dogs; this placement was done in order to draw the dogs away from the target corner so that they could return to it and respond again after being reinforced. The researcher sat on a chair in the centre of the room and did not interact with the dogs. Each time a dog broke the infrared beam, a buzzer sounded; immediately upon hearing the buzzer, the researcher activated the MannersMinder® using a remote control and treats were delivered.

Two dogs were used in this procedure (Table B.1): they were allowed to enter the room (with which they were unfamiliar) and explore freely, one at a

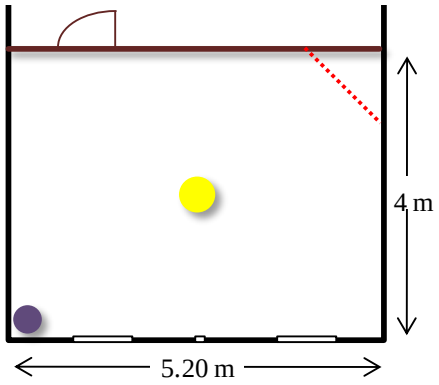

Figure B.2. Layout of the room (a section of the Training Room 2 at the training facility) and equipment in Procedure 1. The MannersMinder® (purple circle) was in the opposing corner from the infrared transmitter and receiver (the infrared beam is shown as a red line). The researcher (yellow circle) was sitting in the centre of the room.

time. Both dogs had one 30 min session; each of the dogs broke the infrared beam once and received one instance of positive reinforcement (Table B.2). Neither dog learned the task in this procedure during the allotted time.

Because this procedure resulted in so few instances of reinforcement, the task and the layout of the room was modified with the goal of increasing the number of successful responses performed by the dogs.

Procedure 2

The aim of this second procedure was for the dogs to learn to pass through the gap in a barrier. This procedure was trialled in the same room. A partial barrier was created approximately two-thirds of the way along the room, with a gap in the centre of the barrier so that dogs could pass through it and explore the remaining one-third of the room (Figure B.3). The two dogs who had participated in the first procedure were used again here, with the addition of three other dogs (Table B.1).

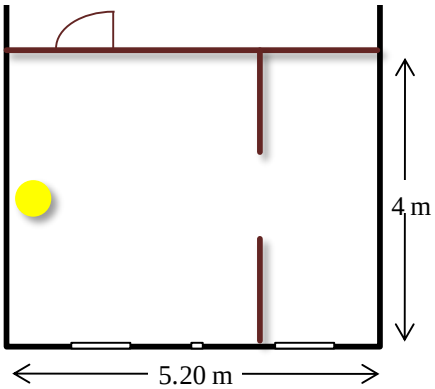

Figure B.3. Layout of the room (a section of the larger training room at the training facility) and equipment in Procedure 2. The researcher (yellow circle) was sitting opposite the partial barrier (two brown lines) through which the dogs were supposed to pass.

The dogs were tested individually, and were allowed to explore the room freely. The researcher sat at the opposite end of the room from the partial barrier and used a clicker (which dogs had been trained to respond to prior to their sessions) and threw a treat on the ground in front of her as soon as the dogs moved through the gap in the partial barrier.

In a 10 min session, one dog (Kimchi) passed through the gap repeatedly and received 46 instances of positive reinforcement (at which stage the food treats ran out so the session ended); and a second dog (Benny) received 129 treats for moving through the gap continually in one 30 min session (Table B.2). The other dogs received between two and 21 treats in sessions lasting 30 (for Lara) to 90 min (for Apple and Flint; Table B.2).

Although the response rate was higher in this procedure, further modifications were done in an attempt to get more successful responses from a larger proportion of dogs.

Procedure 3

A third experimental procedure aimed to train dogs to put their noses in a hole in the side of a cardboard box. This procedure was set up was tested in the same room, albeit with the previously-partial barrier now being completely solid, making the room smaller by approximately one third (Figure B.4). Two cardboard boxes were placed in the room. These boxes had solid sides except for one hole, 10 cm in diameter, on the vertical front-facing side of each box. Both boxes contained a food treat that could be smelt but not physically accessed by the dogs – acting as a kind of 'lure'. It was hoped that investigatory sniffing of a food item might be a more salient task for dogs and thus it might result in successful responses by more dogs. Three dogs, all of whom had been used in one or both of the previous procedures, were used in this set up (Table B.1). The dogs entered the room singly, and were allowed to explore. The researcher sat on a chair at the opposite end of the room from the cardboard boxes and did not interact with the dogs. Whenever a dog put its nose into the hole in the left-hand cardboard box, the researcher delivered a beep (to which dogs had been trained to respond) and threw a treat on the floor directly in front of her.

One dog (Kimchi) received 76 reinforcers in her second 30 min session (she only received one reinforcer in her first 30 min session); the other two dogs, Apple and Flint, completed one 30 min session each and received three and 19 treats respectively (Table B.2).

The number of responses gained by Flint may be attributable to incidental responses during his systematic destruction of the cardboard boxes, rather than true responses per se. The next step in the pilot study included trialling sturdier equipment.

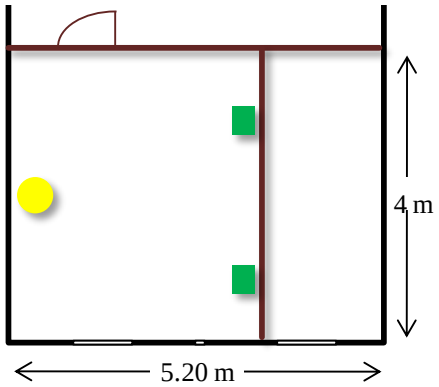

Figure B.4. Layout of the room (a section of the larger training room at the training facility) and equipment in Procedure 3. The researcher (yellow circle) was sitting opposite two cardboard boxes (green rectangles), one of which the dogs received positive reinforcement for investigating.

Procedure 4

The aim of this procedure was for the dogs to put their noses inside the open top of one of two boxes. The set up of the fourth procedure of the pilot study was the same as the third, except that the cardboard boxes were replaced with open-topped plastic boxes, one yellow and the other blue, and these boxes did not contain a treat. The dogs were reinforced for putting their noses inside the left hand (yellow) box. Eight dogs took part in this procedure, one of whom (Benny) had also participated in the second procedure of the pilot study (Table B.1).

Seven of the dogs had two 30 min sessions and the eighth dog (Jack-1) had three 30 min sessions. Two dogs performed the task repeatedly in their second sessions: one (Benny) responding 55 times and the other (Tyson) 135 times (Table B.2). The number of responses made by the other dogs (in any session) ranged from zero to three (Table B.2).

This task appeared to be more salient to the dogs, but the size of room left a lot of other areas to investigate, and the presence of the researcher served as a distraction to some of the dogs. The fifth and final procedure of this pilot study trialled a smaller space and the absence of the researcher.

Procedure 5

The aim of this procedure was again, for the dogs to put their nose into the yellow (target) box. In this procedure the sessions were held in the first dog training room, inside a steel mesh experimental pen (Figure B.1). The experimental pen contained the same two plastic boxes, a dish to catch food (positive reinforcement) being delivered from the adjacent pen, and a water bowl (Figure B.5 and Figure B.6). In accordance with prior procedures, the dogs were trained to associate a beep with the reinforcement (food), before their first session (for more details, see Chapter 4). The food used in this procedure was a dog roll, Possyum, cut into small cubes. During the pre-experiment training, a screen was gradually lowered in between the experimental pen and the adjacent pen where the researcher sat (to re-load the feeding tube), so that the dogs could no longer see the researcher during the experimental sessions. The two boxes had approximately 100 g of cubed Possyum dog roll placed into them overnight which was emptied from the boxes prior to the experimental sessions – with the goal of the scent remaining and acting as a lure for the dogs so that their attention would be drawn to the boxes in a small and otherwise relatively barren environment. The boxes had infrared transmitters and receivers criss-crossing their top, open surface; when dogs investigated the boxes and broke the infrared beams, this was transmitted to a computer that recorded the events. Purpose-written software recorded every infrared beam break and controlled the beep, allowing the delivery

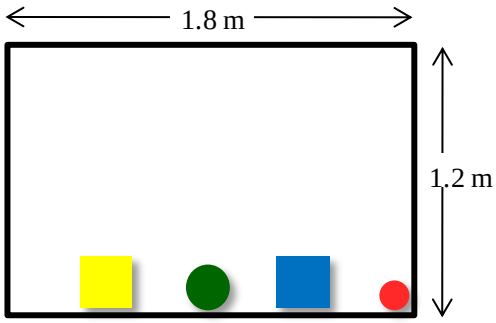

Figure B.5. Layout of the experimental pen in Procedure 5. Two plastic boxes (yellow and blue squares) containing infrared transmitters and receivers were positioned on the ground, on either side of a dish (green circle) into which food treats would drop via the feeder. A bowl of water (red circle) was also present. The researcher was located in the adjacent pen, beside the feeder.

Figure B.6. An example of a dog responding in Procedure 5 by putting their head into the target box.

of the beep (when the dogs investigated the target box only) to be controlled at pre-set delays. Food was delivered by the researcher dropping a piece of food down a tube that ran between the experimental and adjacent pens; the researcher had trained to react quickly to the sound of the beep. All delays were 0 s (immediate reinforcement) in this procedure; and they were unsignalled and non-resetting (responses during the delay had no consequences). Eight dogs took part in this procedure, and they had up to three sessions that ended at 30 minutes or when 200 responses had been made (equating to approximately 100 g of food being delivered), whichever came first. (This fifth and final procedure was settled on as the methodology for the full study; for a more-detailed description of this procedure see the *Method* section in the full study, Chapter 4.)

Seven of the eight dogs to run through this procedure responded repeatedly (Table B.2) with the number of responses in a session ranging from 13 to 199. One dog (Romsey) responded once only (Table B.2).

Summary

Because the final procedure resulted in most of the dogs learning the experimental task, it was adopted as the procedure for the full study (Chapter 4). The data from these dogs were incorporated into the data set for the full study with the exception of one dog, Jemma. Jemma experienced a change in experimental conditions between her first and second sessions in this fifth procedure, and thus she is mentioned in the pilot study only (Table B.1 and Table B.2).

APPENDIX C:

CHAPTER 4 PILOT STUDY 2 – INCREASED LURES

Introduction

In the study presented in Chapter 4, where positive reinforcement was delayed during an experimental training situation, the dogs were required to investigate one of two boxes in order to receive positive reinforcement. It was found that some dogs did not investigate either box very often in Condition 1 and Condition 2 of this experiment. The boxes were scented with dog food (as explained previously in Chapter 4). The goal was for the scent to act as a lure, enticing the dogs to investigate the boxes; and the experimental pen was presented as a relatively barren environment so that the dogs would be more apt to investigate the novel, food-scented boxes. However, as some dogs did not investigate either box very often, it was hypothesised that perhaps this lure was not of sufficient strength to attract all dogs' attention.

If a dog's attention is not being maintained effectively in real-life training situations, then it is common practice to alter some variables in the situation. For example, a trainer might attempt exaggerated body movements or tone of voice, or they may try to increase the attractiveness of the lure they are using (e.g., Dunbar, 1996). In this experiment these options were limited to increasing the appeal of the lure. So in response to some dogs' low levels of exploratory behaviour in the first two conditions, a slight variation on the procedures was trialled prior to the third condition.

Method

Four dogs were selected randomly for participation in this pilot study, with the constraint that they had failed to learn the experimental task in the condition that they were to be re-tested in. The dogs were Mac and Ruby-1, who had both failed to learn the task in Condition 1; and Bella-1 and Daisy, who had not learned in Condition 2 (or when switched to Condition 1). These four dogs were re-tested in their original condition, this time with an increased lure.

The methods were exactly the same as those described in Chapter 4 with one exception: this time a stronger food 'lure' was used. A small (14.5 x 14.5 cm) plastic box was securely fastened inside the bottom of each box. The lids of these containers was perforated with 25 holes (approximately 3 mm diameter), and 100 g of Possyum food was placed inside these containers.

Results and Discussion

One dog in each condition learned the task. Ruby-1 learned in Condition 1 (Figure C.1) and Daisy learned in Condition 2 (Figure C.2).

From these results it was concluded that the increased lure may have had some effect for some dogs, but it was decided to retain the same methodology in the signalled delay condition for the sake of consistency. This is an aspect that is worth investigating in future research.

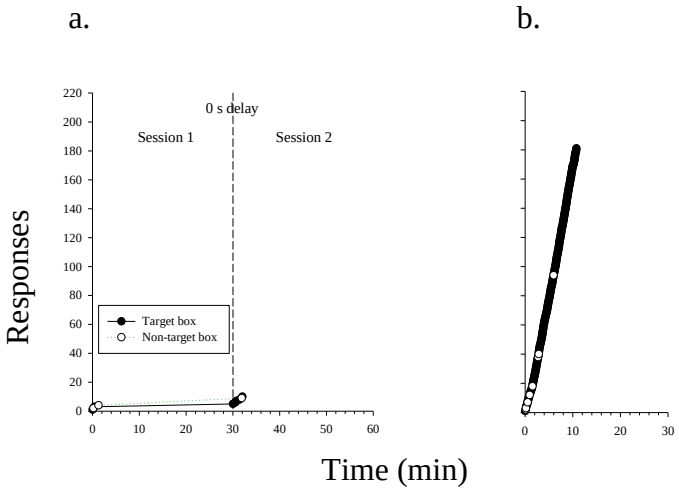

Figure C.1. Cumulative responses performed by Mac (a) and Ruby-1 (b) with a 0 s delay to delivery of positive reinforcement in Condition 1, albeit with the addition of a stronger food-lure in the boxes. The broken vertical line denotes a change of sessions.

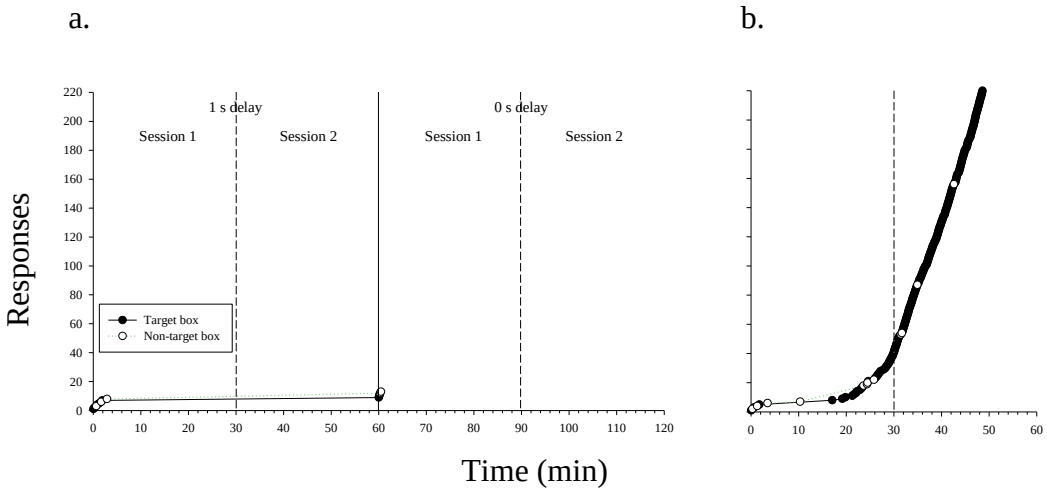

Figure C.2. Cumulative responses performed by Bella-1 (a) and Daisy (b) with a 1 s delay to delivery of positive reinforcement in Condition 2, albeit with the addition of a stronger food-lure in the boxes; and then a switch to a 0 s delay to reinforcement (Condition 1). The broken vertical lines denote a change of sessions, and the solid vertical lines denote a change of conditions.

APPENDIX D: CHAPTER 5 FIGURES

In the study described in Chapter 5, owners gave their dogs post-response feedback in a variety of ways. One figure illustrating the order and timing of the types of feedback events was provided in Chapter 5; the remainder of the owner-dog dyads' data are presented here.

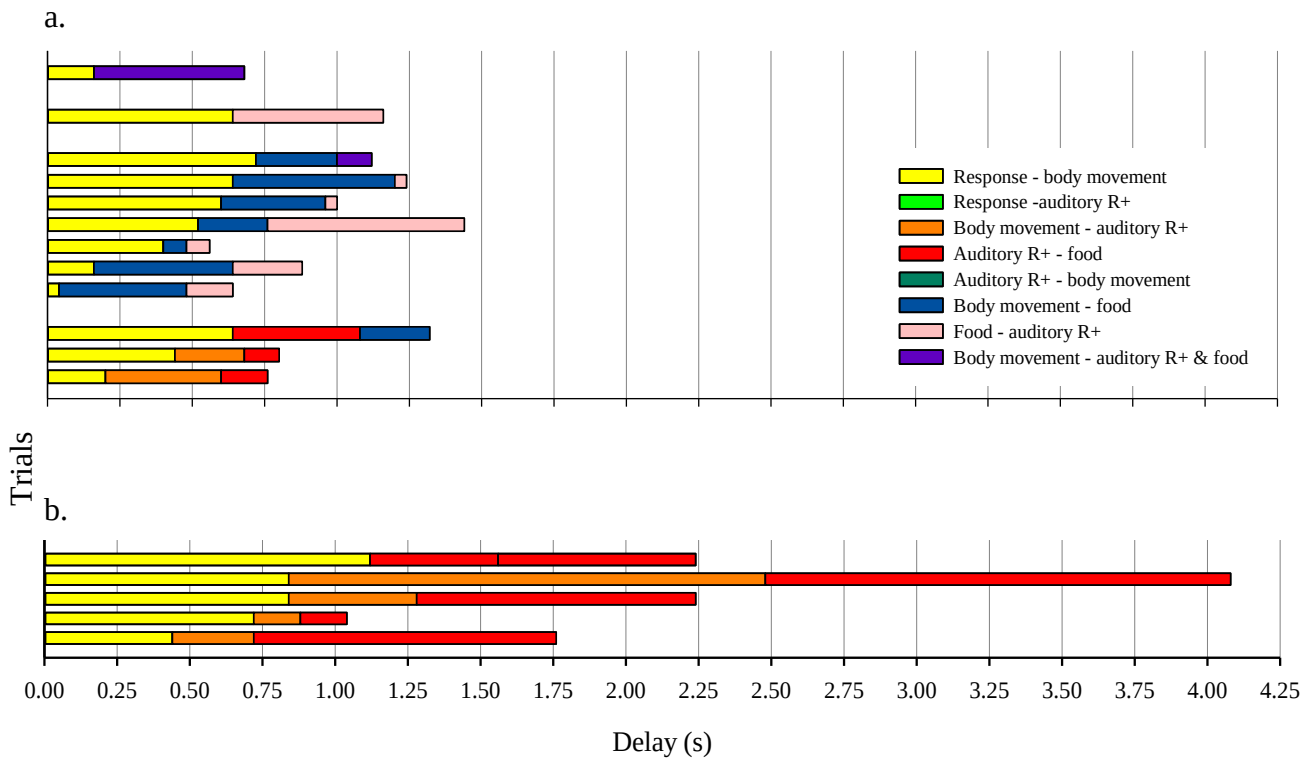

Figure D.1. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.2 and Bovril (N = 12 trials; a), and Owner 5.3 and Beau (N = 5 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

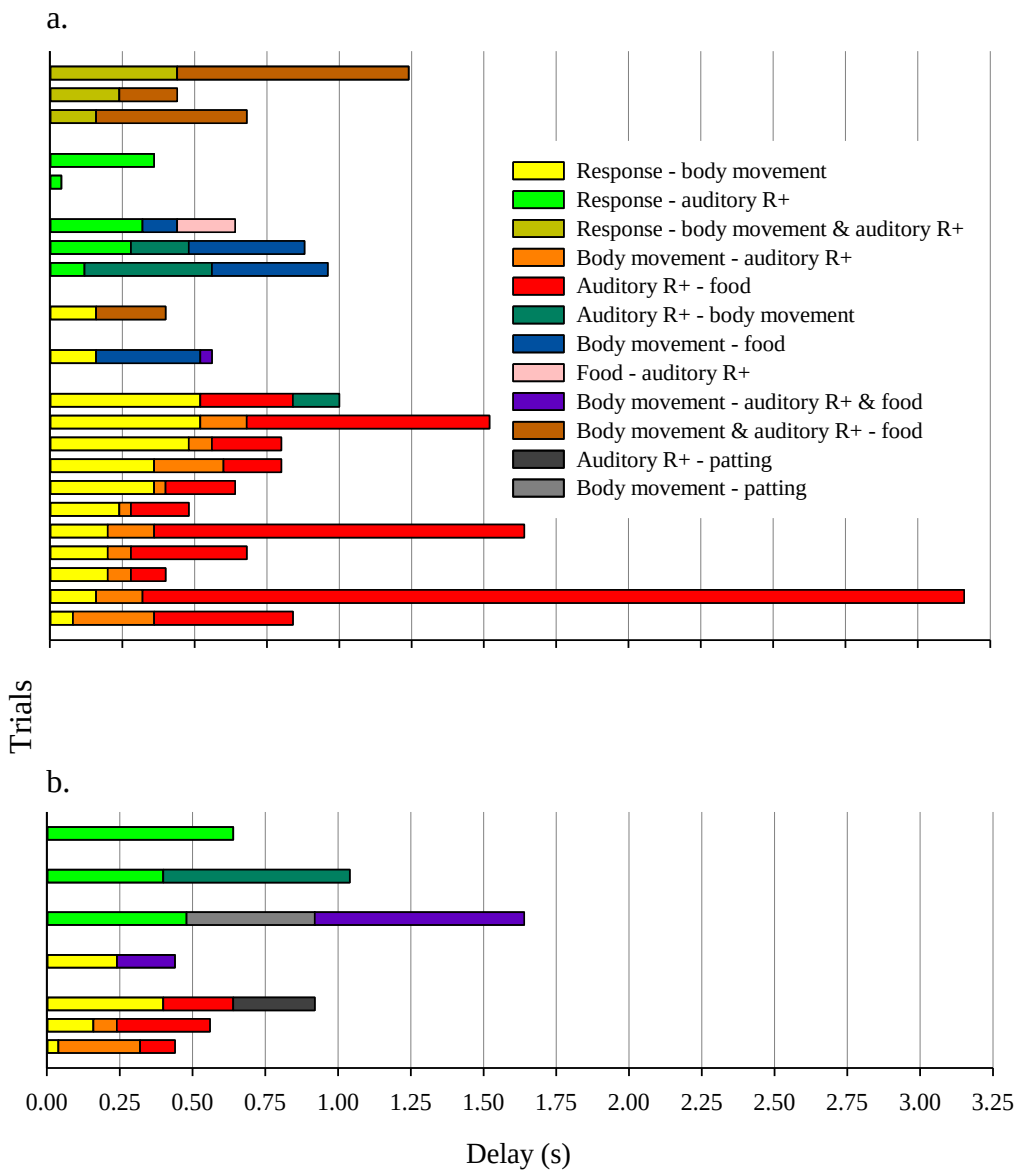

Figure D.2. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.4 and Pebbles (N = 21 trials; a), and Owner 5.5 and Jaffa (N = 7 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

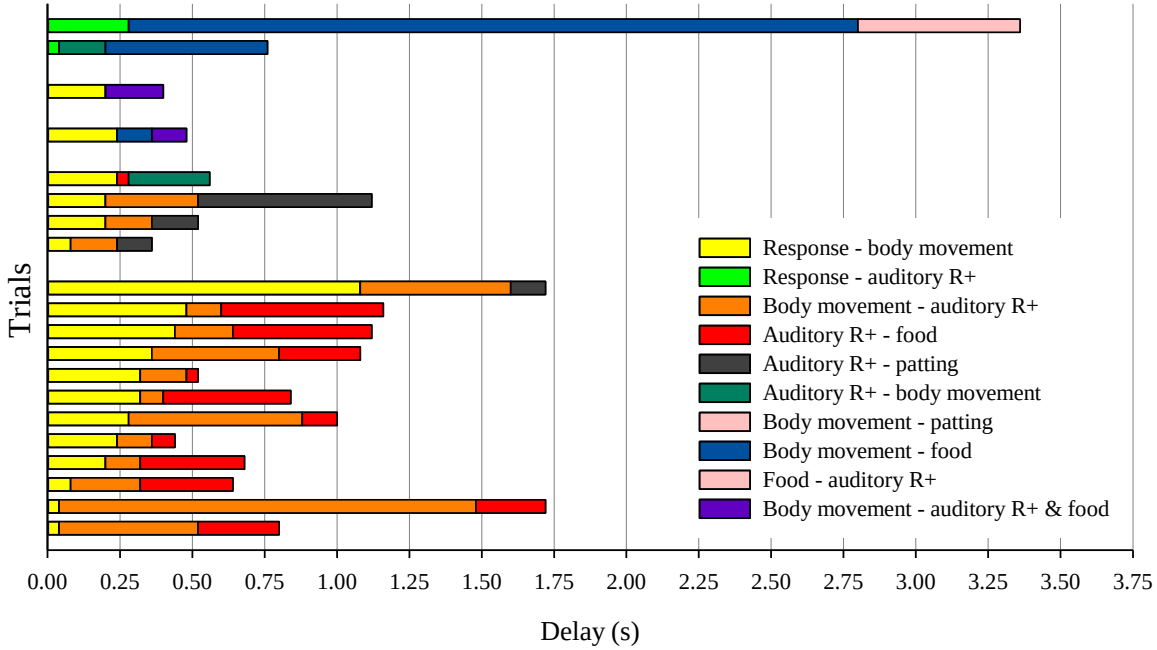

Figure D.3. Feedback given by Owner 5.6 following Fynne's responses (at time = 0 s) during a 10 minute training session. Different types of feedback are given at varying times and in differing orders across trials (N = 20). Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

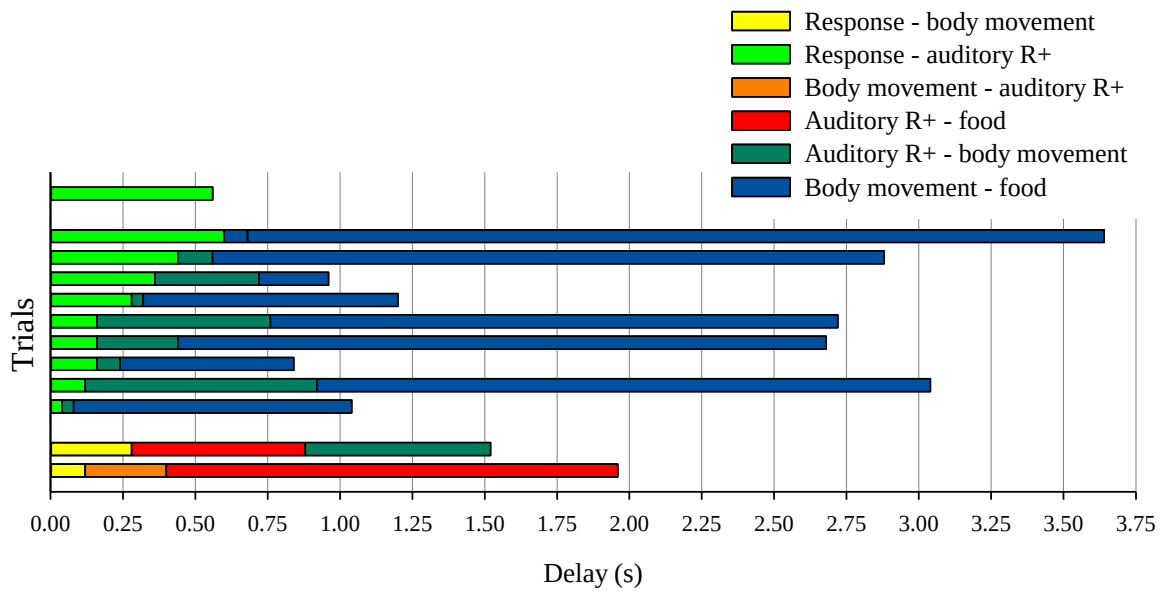

Figure D.4. Feedback given by Owner 5.7 following Robbie's responses (at time = 0 s) during a 10 minute training session. Different types of feedback are given at varying times and in differing orders across trials (N = 12). Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

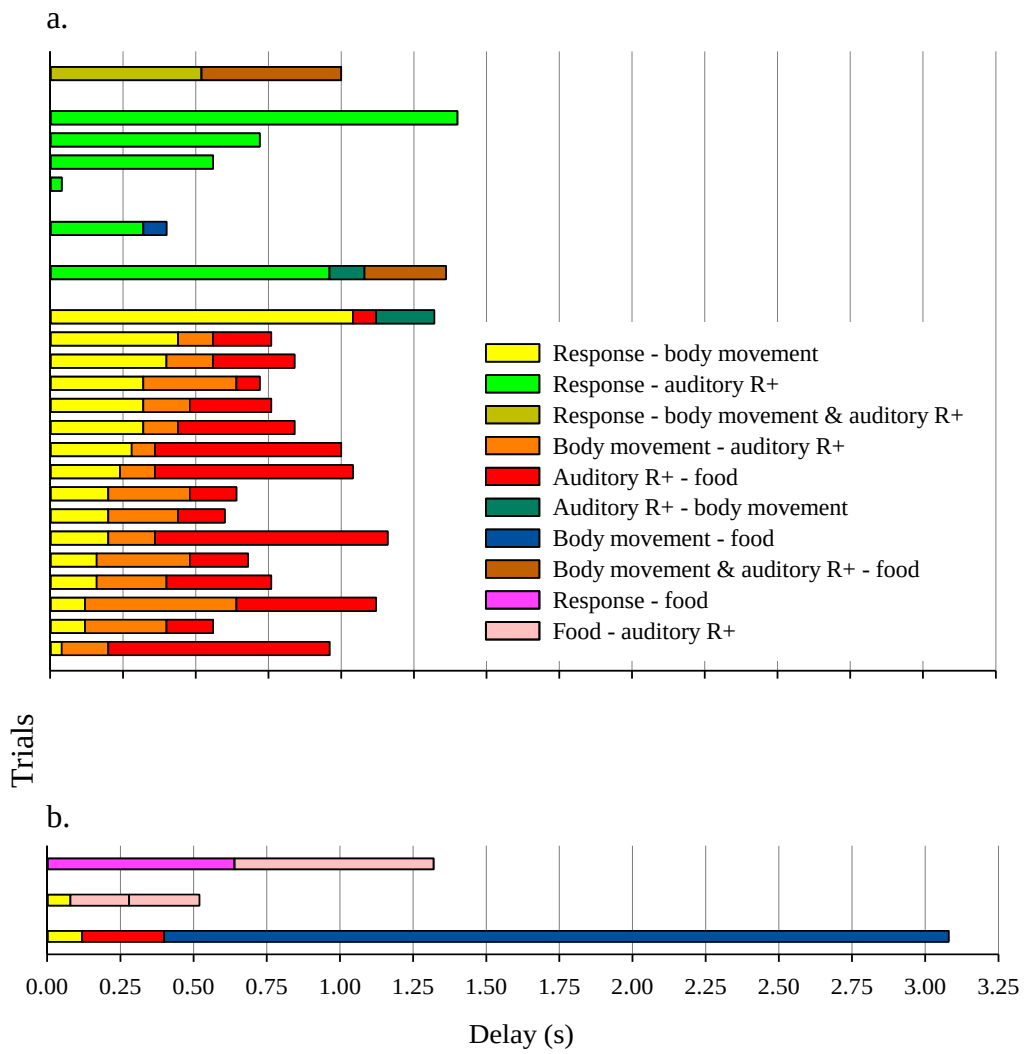

Figure D.5. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.8 and Baxter (N = 23 trials; a), and Owner 5.9 and Pippi (N = 3 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

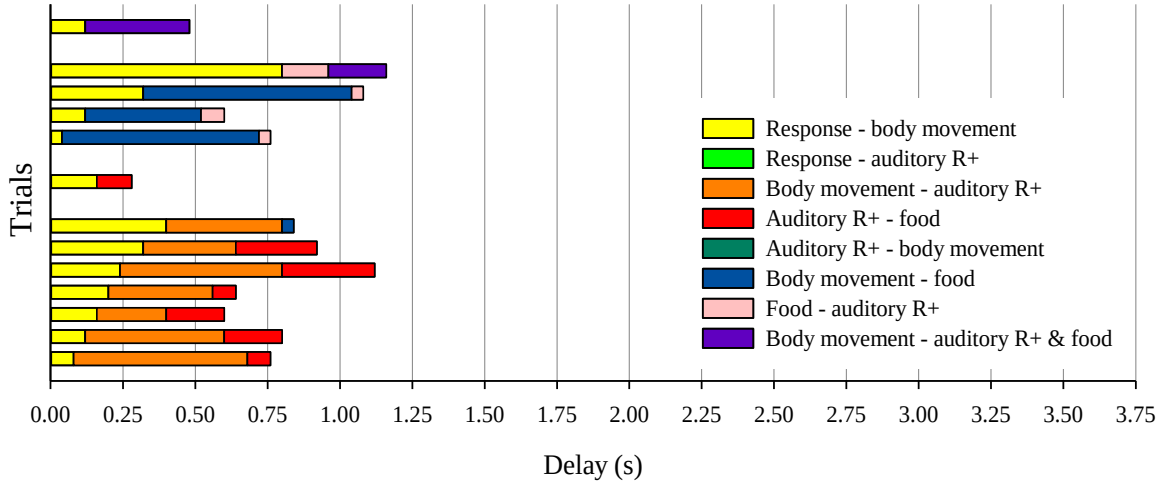

Figure D.6. Feedback given by Owner 5.10 following Shiloh's responses (at time = 0 s) during a 10 minute training session. Different types of feedback are given at varying times and in differing orders across trials (N = 13). Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

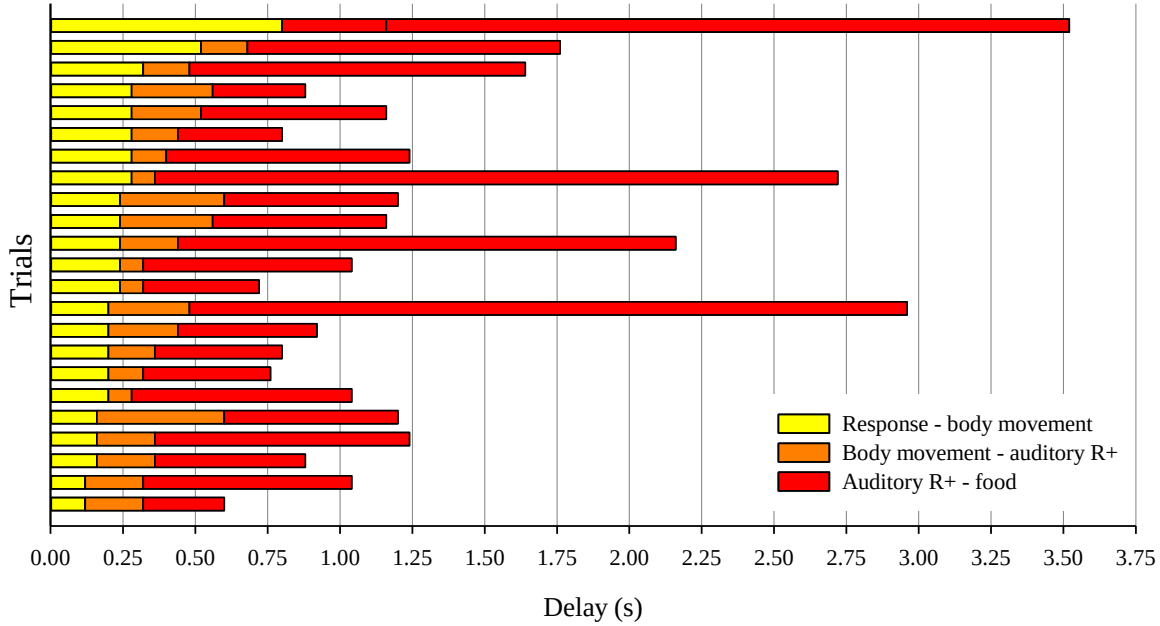

Figure D.7. Feedback given by Owner 5.11 following Petra's responses (at time = 0 s) during a 10 minute training session. Different types of feedback are given at varying times and in differing orders across trials (N = 23). Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

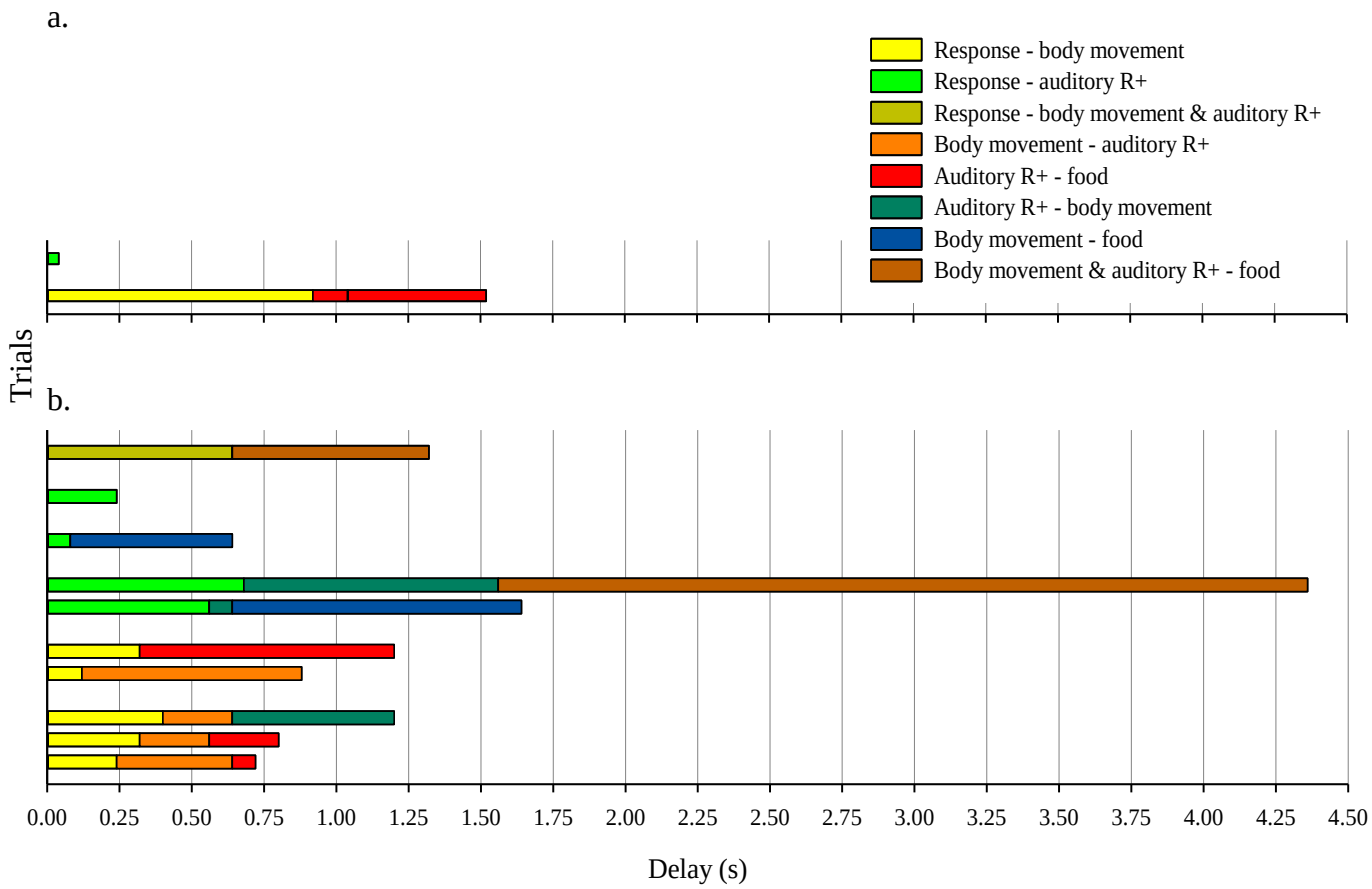

Figure D.8. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.12 and Elmo (N = 2 trials; a), and Owner 5.13 and Moses (N = 10 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

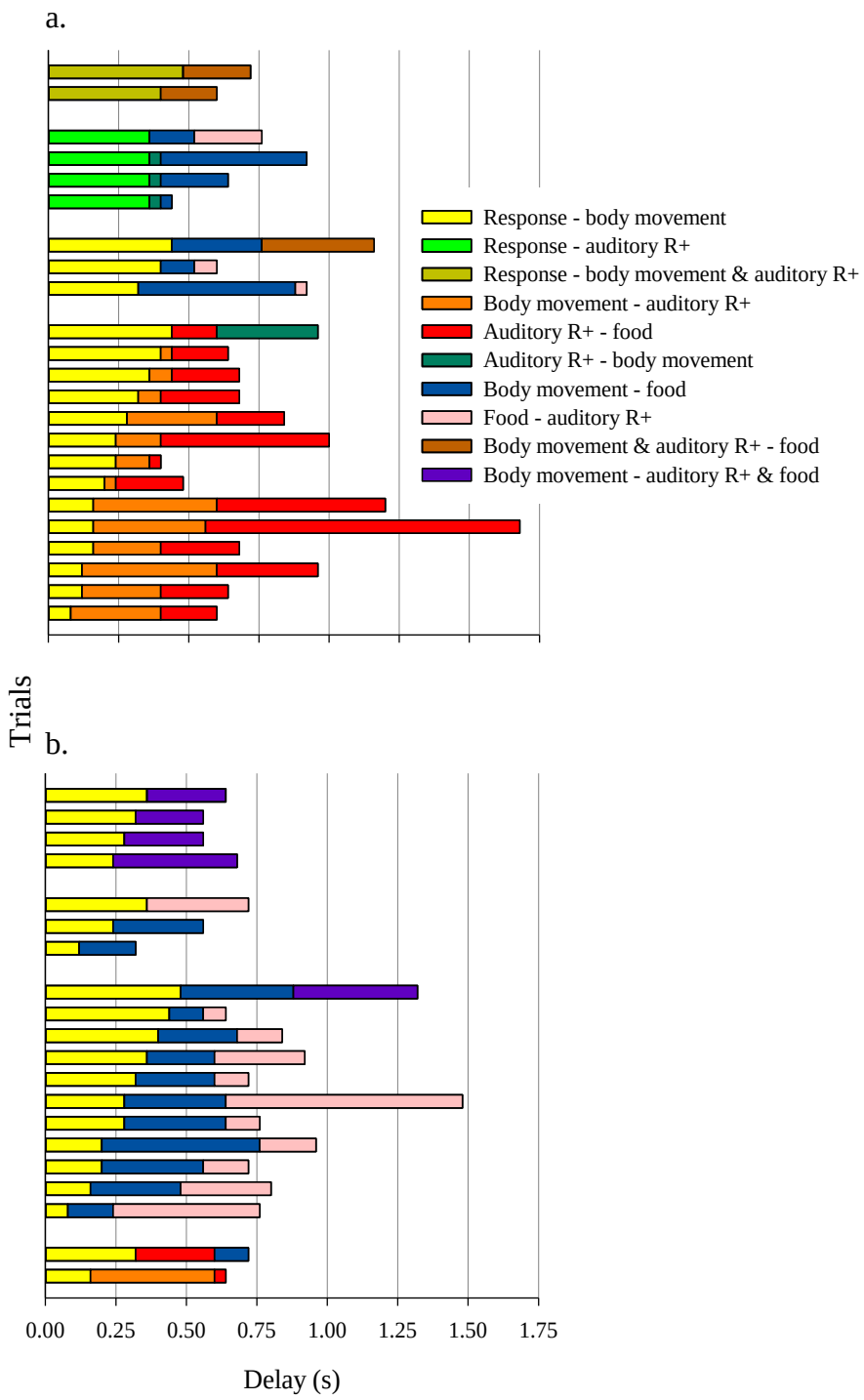

Figure D.9. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.14 and Shadow (N = 23 trials; a), and Owner 5.15 and Snozz (N = 20 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

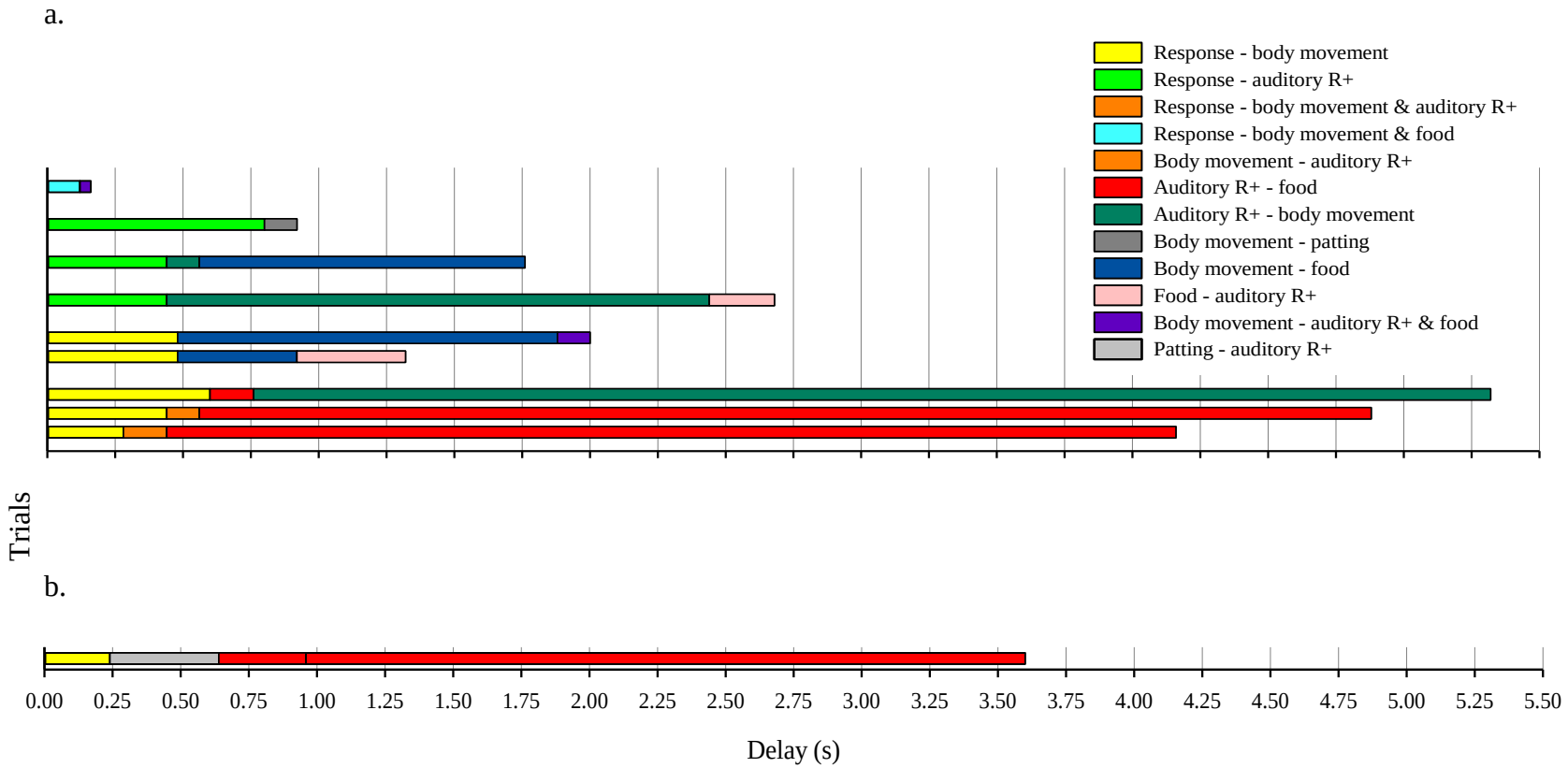

Figure D.10. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.16 and Jack (N = 9 trials; a), and Owner 5.17 and Michael (N = 1 trial; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

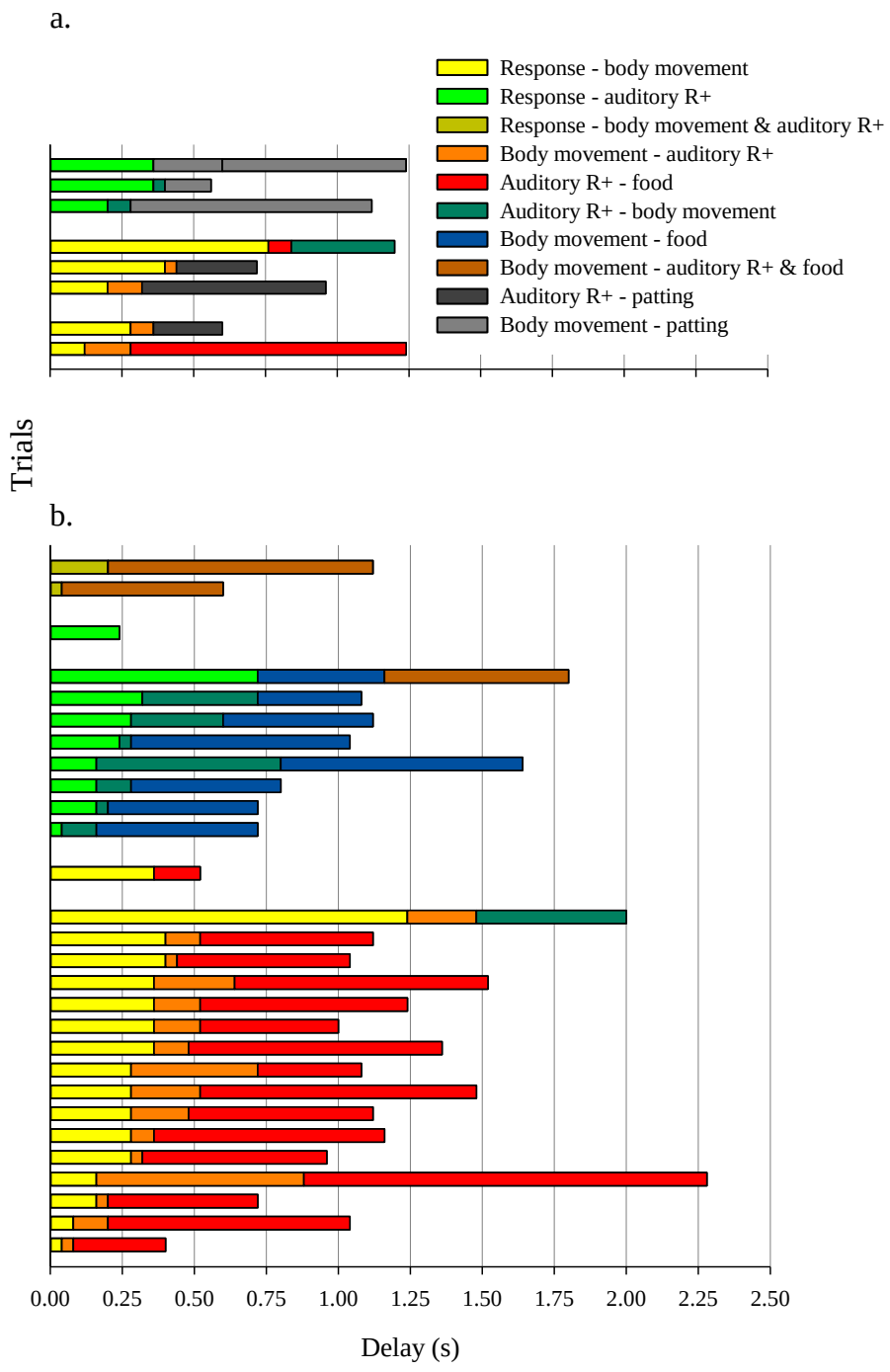

Figure D.11. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.18 and Grace (N = 8 trials; a), and Owner 5.19 and Tessie (N = 28 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.

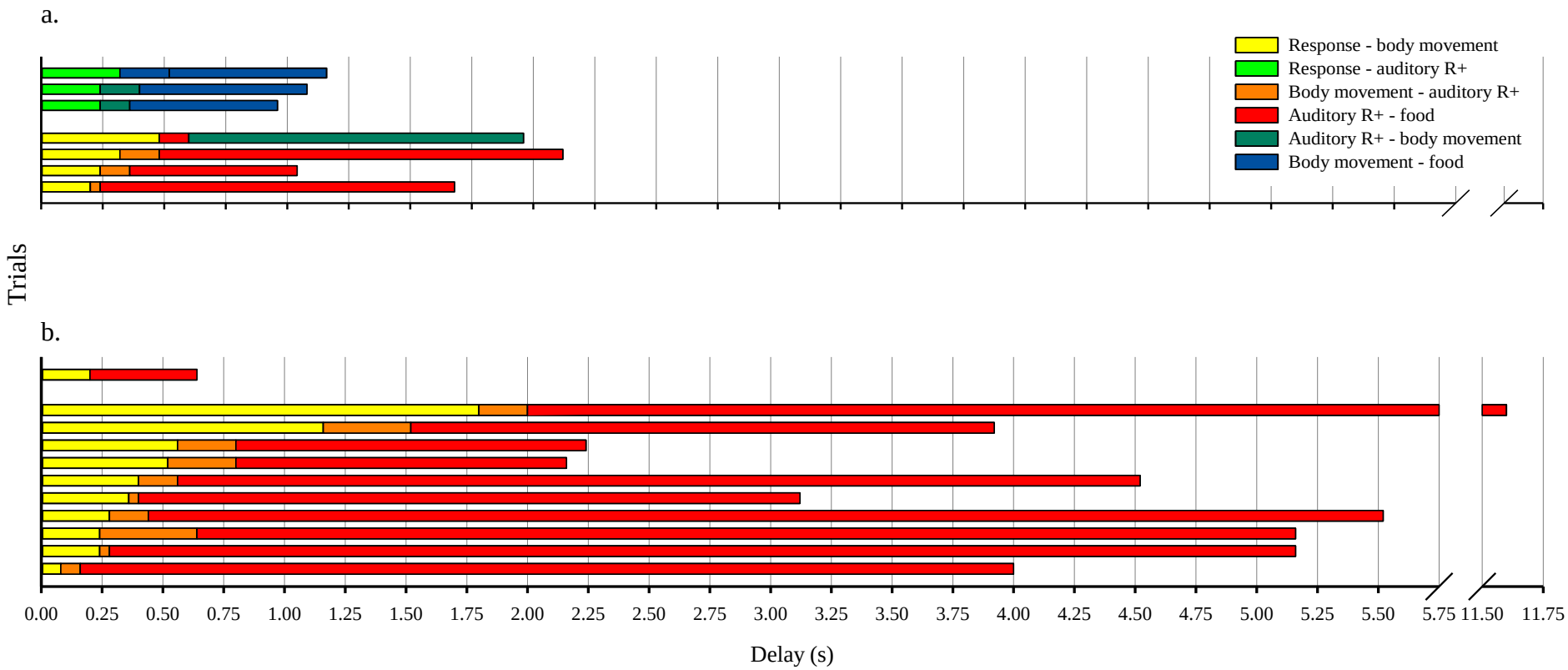

Figure D.12. Feedback given by owners following their dogs' responses (at time = 0 s) during a 10 minute training session; Owner 5.20 and Murphy (N = 7 trials; a), and Owner 5.21 and Sasha (N = 11 trials; b). Different types of feedback are given at varying times and in differing orders across trials. Trials are presented in ascending order of time to first feedback, grouped by the different sequences of events within trials. R+ = positive reinforcement.