



RESEARCH

Influence of delayed timing of owners' actions on the behaviors of their dogs, *Canis familiaris*

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Abstract This study examined the influence of delayed actions from the owner, including commands, reinforcement, and punishment, on already-learned behaviors in 10 dogs. The delay times were set to 2.0, 1.0, 0.5, 0.27, and 0.13 seconds (s). Responses to commands with a delay (Delayed) were compared with those that were not delayed (Nondelayed). The results indicated that appropriate responses to commands decreased in 2.0, 1.0, and 0.5 s delayed conditions. As delay time increased, response to commands decreased. The numbers of commands used by handlers to make their dogs obey was significantly increased with a 2.0 and 1.0 second delay compared to the nondelayed trials. The time required for dogs to obey the commands was significantly increased in 2.0, 1.0, and 0.5 s delayed conditions compared to those of the nondelayed trials. There were no significant differences between the 0.27 s, 0.13 s, and the nondelayed condition. These results suggest that timing is an important factor affecting a dog's behavior not only while learning new things, but also in the production of learned desirable behaviors that could occur during everyday interactions.

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Introduction

A dog's response to commands is influenced not only by the relationship with its owner, but also the owner's dog-handling ability. Professional dog trainers can sometimes control dogs better than their owners, and often dogs obey the trainers' commands better even during their first interaction. This finding suggests that there is a skill to giving commands, and appropriate rewards or punishment, to elicit desired behavior from dogs.

Human behavior seems to affect a dog's behavior and response to commands. For example, some dogs may find hidden food by following human gestures and focus of

attention, including pointing, head turning, nodding, and gazing toward the target (Miklósi et al., 1998; Hare and Tomasello, 1999; Agnetta et al., 2000; McKinley and Sambrook, 2000; Soproni et al., 2002; Riedel et al., 2006). Other studies indicate that dogs may read a person's attentional state and change their response to cues depending on a human's attentional focus (Call et al., 2003; Virányi et al., 2004; Schwab and Huber, 2006). These studies revealed that dogs were able to perceive the attentional state of their owners by judging observable behavioral cues, such as eye contact and eye, head, and body orientation (Call et al., 2003; Virányi et al., 2004; Schwab and Huber, 2006) and obeyed commands better when they received more attention from their owners than when they got less attention. Moreover, Fukuzawa et al. (2005) demonstrated the importance of visual cues given by humans, in addition to their verbal cues, on eliciting appropriate responses in dogs.

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Timing of rewards and punishment is an important factor that will affect dogs' training behavior, especially if handlers need to reward or punish dogs as soon as the responses are observed (Reid, 1996). In the performance of service dogs and their users, Coppinger et al. (1998) also reported that timing must be precise. Many studies on timing have indicated that delayed reinforcement and punishment will retard classical conditioning in dogs and rabbits (Ellison, 1964; Schneiderman, 1966) and operant conditioning in dogs, rats, pigeons, and humans (Solomon et al., 1968; Baron et al., 1969; Andrew and Braveman, 1975; Lattal and Gleeson, 1990; Dickinson et al., 1992; Critchfield and Lattal, 1993; Neef et al., 1994; Schlinger and Blakely, 1994). However, all these studies focused on the acquisition of new behaviors. Ohnishi et al. (2003, 2004) examined the effects of delayed reinforcement and/or punishment on verbal conditioning to audio communication and showed that a delay of as little as 0.3 seconds (s) retarded the already-conditioned response in humans, indicating that performance of already-learned behaviors can be retarded by delayed reinforcement and/or punishment.

Owners sometimes command their dogs to perform behaviors they are already performing or command their dogs to perform behaviors when the dogs are not paying attention. They also sometimes attempt to reward dogs when dogs are not paying attention or show no response to the "reward" and further punish dogs when they are not responding to the punishment. Rooney et al. (2001) found that the signals that humans used most frequently to encourage dogs to play were ineffective. It appeared as though the owners did not pay attention to the responses of their dogs when determining how to elicit specific behaviors. These mismatches between owners and their dogs could influence the dogs' reaction to commands. Although the importance of timing is emphasized in the training of dogs and dogs change their behaviors depending on the handler's behavior as mentioned above, there are few studies that examine the influence of mismatch between owners and dogs. For example, it is not known how delays in presentation of commands, rewards, or scolding would affect a dog's performance of already-learned behaviors such as "sit" and "lie down." In this study, the authors examined the overall mismatch between what owners do relative to the current behavior of their dogs, and to how dogs subsequently respond to the owner. If owners' actions, such as timing of commands reinforcement, and punishment (scolding), are delayed, there may be a decrease in the probability of the dog obeying the command or showing other preferable behavior such as focusing on the owner. The aim of this study was to examine the effect of delayed actions from the owner, including commands, reinforcement, or punishment, on dogs' already-learned behavior and the dogs' attention to their owners.

Materials and Methods

Ten dogs, *Canis familiaris*, of various breeds consisting of 8 males and 2 females, were used in this study (Table). These

Table Subjects for all experiments

Breed	Gender	Age (mo)
Border collie	Male	48
Flat-coated retriever	Female*	47
German shepherd dog	Male*	26
Labrador retriever	Male*	53
Labrador retriever	Male*	53
Labrador retriever	Male*	53
Labrador retriever	Male	60
Miniature dachshund	Male	27
Mix	Female*	27
Standard poodle	Male	72

*Neutered.

dogs had been trained to "sit" and "lie down" and obeyed more than 80% of 20 commands (10 "sit" and 10 "lie down," presented randomly). During the process of selecting dogs for this experiment, the owners commanded their dogs as they would normally, with face-to-face interaction. Therefore, owners were allowed to provide both verbal and visual cues in addition to their usual methods of praising and scolding their dogs. In this experiment, praise or reward included words such as "good" and treats, whereas punishment or scolding included words such as "no" or speaking to the dogs in a loud voice that is apparently aversive to the dogs. Owners presented 20 commands in the selection test, and if the dog did not obey the command within a few seconds, the behavioral response was defined as incorrect. During the experiment, owners were required to make their dogs obey 5 commands (3 "sit" and 2 "lie down") using the same cues, but in this situation the dogs and handlers were in separate rooms and the dogs were shown a life-size image of the handler projected on a screen in front of them while the handler's voice was projected via speakers located next to the screen. In the nondelayed condition, the responses to commands projected by video were almost the same as the responses elicited during the selection test. In the test, a correct "sit" was defined by the dog's rump touching the floor, and a correct "down" was defined by the dog's elbows touching the floor. All the dogs were kept as pets, and their owners acted as their handlers.

For experiments on delay, it was important that the subjects be blind to the experimental procedure. In this study, we used delay devices (sound: Boss DD-20 Digital Delay, image: Ito Co., Kakoroku) and arranged the setup to conduct blind experiments with handlers and to control the delay periods. Two rooms were prepared for the experiments (Figure 1); the dogs and the examiner were in room 1 (12 m x 6 m) and the handlers were in room 2 (5 m x 1 m). The rooms were separated enough so that sound could not be heard from the other room. The movements of the examiner and dog were recorded by video camera in room 1 (Hitachi DZ-HS403; Tokyo, Japan), and the image was played on a TV (Sony KV-14AF1; Tokyo, Japan) in room 2. The movement and voice of the handler was

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