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Dogs (*Canis familiaris*) Learn From Their Owners via Observation in a Manipulation Task

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Eighty-seven pet dogs (*Canis familiaris*) were involved in an experiment in which they had to solve a task to obtain a ball. After witnessing a full demonstration by their owner (10 times pushing the handle of the box, which released a ball), most dogs preferred to touch the handle sooner and more frequently in comparison with other parts of the box, and they used the handle to get the ball. In contrast, dogs in 3 control groups developed their own respective methods. The lack of emergence of the ball and playing after the demonstration did not affect the learning performance strongly. This suggests that in dogs the outcome of a demonstration plays only a restricted role in the manifestation of social learning.

There has been an increased interest in studying behavioral phenomena of social learning, which is considered to be an important manifestation of intelligence in nonhuman species. Many argue that studying social learning in animals can also provide further details about the possible role social learning might have in forming human behavior (i.e., Baldwin, 1895; Morgan, 1900). According to the definition of Whiten and Ham (1992), social learning takes place "when B learns some aspect of the behavioral similarity from A" (p. 248).

Until now, much effort has gone into understanding mechanisms of social learning by dividing it into meaningful categories such as stimulus enhancement, observational conditioning, goal emulation, imitation, and so on (for reviews, see Byrne & Russon, 1998; Galef, 1988; Heyes, 1993; Whiten & Ham, 1992; Zentall & Akins, 2001). Stimulus enhancement is used when the activity of a demonstrator draws the attention of an observer to a particular object (e.g., a lever). Quite often stimulus enhancement cannot be distinguished from local enhancement, in which the demonstrator's actions merely focus the observer's attention on some of the contextual stimuli (i.e., the place in the environment where the object is located). In other cases, a Pavlovian association may be established when the observer learns the relation between some part of the environment and the goal of the demonstrator's action as a reinforcer (Heyes, 1994). In a food-getting task, a demonstrator in action may only draw the observer's attention to the object manipulated and the observer's orientation to the object is often followed immediately by presentation of food. This may result in a conditioning process that has been called valence transformation (Hogan, 1988), emulation (Tomasello, 1990), or observational conditioning (Whiten & Ham, 1992). According to this conditioning paradigm, acquisition may be impaired when the reward of the demonstrator's action cannot be observed (Akins & Zentall, 1996; Heyes, Jaldow, & Dawson, 1994).

True imitation has been defined as the "copying of a novel or otherwise improbable act or utterance, or some act for which there is clearly no instinctive tendency" (Thorpe, 1963, p. 135). In other words, the target behavior should not already be part of the observing animal's repertoire (Clayton, 1978). Because it is not easy to determine the repertoire of an animal, "imitation is then defined as a relatively large increase in the probability of the demonstrated response, relative [to] that of an appropriate group that controls for all of the already-noted non-imitative causes of such behavior" (Zentall & Akins, 2001, Imitation section).

Over the last 10 years, the alternative methods approach—the so-called two-action method—has become widely used in social-learning studies, which seems to offer a technical possibility of distinguishing between imitative and nonimitative social learning (see Akins & Zentall, 1996; Custance, Whiten, & Fredman, 1999; Heyes, 1993; Heyes & Dawson, 1990; Voelkl & Huber, 2000; Whiten, Custance, Gomez, Teixidor, & Bard, 1996; Whiten & Ham, 1992). This experimental design involves presenting two or more groups of observers with the same experimental object, but

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they see the demonstrator manipulating it using one of (at least) two alternative methods.

In most experimental demonstrations of social learning, demonstrators receive some kind of reward after successful performances, and indeed observers seem not to learn by observation if demonstrators are not rewarded for their actions (e.g., Palameta & Lefebvre, 1985). This might explain arguments suggesting that social learning is under strong control of associative processes (see Heyes, 1993, 1994). This view is perhaps based on the assumption that social learning is mainly concerned with social transfer of feeding techniques in various species (see also Bilkó, Altbäcker, & Hudson, 1994; Broom, 1999; Galef, 1988, 1990; Palameta & Lefebvre, 1985). Not denying this, we argue there is still a possibility that observers would learn socially if the action of the demonstrator did not involve any immediate recognizable goal or reward and if reinforcement of any kind has a minor role (Huber, 1998; Miklósi, 1999).

Usually social transmission of information takes place among individuals belonging to the same species. Nevertheless, there could be special cases in which heterospecific transfer might occur. A recent study (Fritz, Bisenberger, & Kotrschal, 2000) underlined this possibility when human-imprinted geese were found more likely to open a box filled with food after having observed a human demonstrator. Orangutans preferred to imitate the actions of demonstrators with whom they had positive affective relationships. It can be argued that because the observer is more familiar with the general motor patterns of the demonstrator, this can help him recognize significant changes in the demonstrator's behavior (Russon & Galdikas, 1995). However, if the anatomy of the demonstrator and observer differs, it is hard to decide whether a similar action could be labeled as imitation (for a more detailed discussion, see Fritz et al., 2000). The hierarchical approach of learning by imitation (program level imitation, see Byrne & Russon, 1998) could offer a solution for this problem.

Dogs could be good candidates for investigating social learning for two reasons. First, their closest relative, the wolf (Vilá et al., 1997), is well-known for living in highly organized social groups and displaying complex social relationships among group members (Mech, 1970). It is experimentally proven that dogs are able to learn some aspects of the behavior of a conspecific. Both same-age puppy demonstrators (Adler & Adler, 1977) and trained mothers (Slabbert & Rasa, 1997) seemed to be efficient in socially transmitting information to naive puppies.

Second, it could be presumed that during domestication dogs acquired special behavior-controlling mechanisms, which allowed them to build an especially close relation to humans. Indeed, recent experimental studies have shown that dogs also display instances of social learning when they are given the chance to learn from humans (Pongrácz, Miklósi, Kubinyi, Gurobi, & Csányi, 2001; Pongrácz, Miklósi, Kubinyi, Topál, & Csányi, 2003). Additionally, as a particular example of social influence, dogs are able to synchronize their behavior with that of their owners without any reinforcement by being able to anticipate the owner's action (Kubinyi, Miklósi, Topál, & Csányi, 2003); this ability might also contribute to their willingness to cooperate with humans in such complex situations as blind leading (Naderi, Miklósi, Dóka, & Csányi, 2001). Human-like attachment behavior in dogs toward their owners (Topál, Miklósi, & Csányi, 1998) and well-adapted communicative abilities for understanding human gestural signals (Hare & Tomasello, 1999; Miklósi, Polgárdi, Topál, & Csányi, 1998; Soproni, Miklósi, Topál, & Csányi, 2001, 2002) underline our main hypothesis that apart from social experience (Frank, 1980; Topál et al., 1998) dogs' genetic preferences could also contribute to their sensitivity for human demonstration (Csányi & Miklósi, 1998). Compared with apes in a two-way food-choice task, dogs, like children, seemed to interpret the test situation as being a form of communication (Soproni et al., 2001). Consequently, Soproni et al. (2002) suggest that this similarity is attributable to the social experience and acquired social routines in dogs because they spend more time in close contact with humans than apes do.

The aim of the current study was threefold. First, we wanted to explore the possibility that dogs might be able to acquire a manipulative behavior by observing a human demonstrator in an alternative method design. Second, we investigated whether reinforcement of the demonstrator's action is necessary for such transmission to take place. Third, we wanted to devise a task that would offer an opportunity to compare the dogs' performances with performances reported in other animal species.

In one of the groups in our experiment, dogs were allowed to watch their owners manipulating a handle that released a ball on the opposite side of a closed box. Some owners pushed the handle to the right, some to the left. The emerging ball was supposed to function as some kind of reward because owners played with the dog after the ball became available. However, the box was designed so that the dogs could get the ball by other means as well (pushing, kicking the box strongly, turning it over, etc.) so that they were not bound to perform only a limited set of actions to attain their goal. Our arrangement seemed to be advantageous because one could easily see the effect of the different demonstration techniques and, additionally, imitative processes (repeating the exact action of the owner, like pushing the handle exactly to the same direction as the demonstrator) could be separated from other nonimitative manifestations of social learning.

Method

The observations were carried out during the springs and summers of 1999 through 2001 at the Top Mancs dog-training school (Budapest, Hungary) and during summer schools for dog trainers (at Zalahaláp, Debrecen, and Törökszentmiklós, Hungary).

Subjects

Eighty-seven dogs (*Canis familiaris*) and their owners were recruited for the present study. Prior to testing, dogs were assigned to different groups by their age and breed. Dogs from at least seven breeds contributed to each group; the breeds came from all major dog groups recognized by the American Kennel Club (sporting dogs, working dogs, etc.). The list of breeds of the participating dogs in the five groups is given in the Appendix. All owners (aged between 18 and 50 years; 71 women and 16 men) volunteered to take part in the test.

Apparatus

The test box (40 × 40 × 15 cm) was made of green plastic sheets (see Figure 1). The top of the box could be opened by the experimenter but was permanently closed during the experiment. The experimenter put the ball in the box by opening the top of the box. On one side of the box there was a wooden handle (25 cm long and 2 cm wide), and on the opposite side there

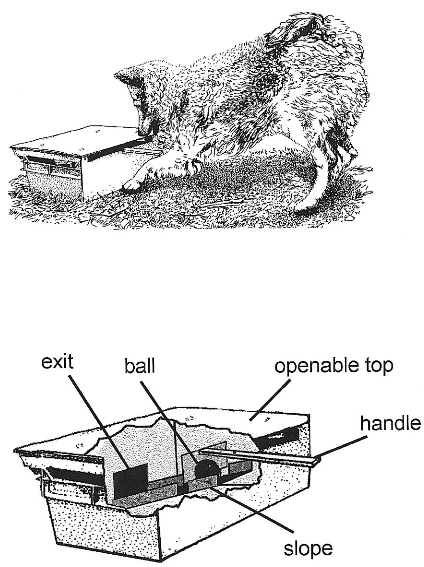

Figure 1. Drawing of a dog pushing the handle of the box (top) and the structure of the box (bottom).

was an aperture where the ball rolled out after the handle was pushed to the left or the right. Because the handle was at the opposite side of the box, the dog had to go around the box to pick up the ball. The box was not fixed to the ground, and many other actions like kicking or pushing the box could lead eventually to the ball rolling out.

Procedure

Subjects were tested individually in a restricted grassy area that was as far away as possible from any disturbing factors. Only the experimenter (Enikő Kubinyi) and the owner were present during trials. A Panasonic VHS-C video camera was fixed on a tripod at a distance of 1.5 m from the box and at a height of 1.8 m. The box was directed with its aperture toward the camera.

Pretesting

Before the experiment, all dogs were tested in five ball-retrieving trials. Only those animals that were successful in bringing back the ball to their owners all five times were included. We wanted to ensure that all dogs in the different experimental groups were similarly motivated in getting the ball and playing with it. Only dogs that passed this test participated in the experiment, which comprised three phases: (a) an odor stimuli control, (b) a demonstration phase, and (c) a test phase. In the demonstration phase, the dogs were randomly divided into five age-, gender-, and breed-matched groups and were subjected to different types of demonstrations. To exclude the effect of the odor of the ball, we placed the ball in the box for each group during the demonstration phase. In the test phase, all dogs were tested in the same way.

Phase 1: Odor Stimuli Control

To control for odor stimuli between the groups, we asked the owners to hold the handle for 30 s before the start of the experimental observation. During this time, the dogs were turned away and the experimenter covered their eyes with her hand to avoid their witnessing the owner's interaction with the box.

Phase 2: Demonstration

Handle push plus ball group (N = 17; 9 males, 8 females; mean age = 2.65 years, SD = 1.54 years). The owner was asked to hold the collar of the dog to keep the dog facing the box at a distance of 50–70 cm from the handle. Before pushing the handle, the owner had to direct the dog's attention to the handle by saying "Look at my hand!" Then, the owner pushed the handle and the ball rolled out. The owner allowed the dog to pick up the ball and played with the dog for a short time (approximately 5–15 s). After the experimenter asked them to finish playing, the owner covered the dog's eyes with his or her hand and gave the ball to the experimenter, who placed the ball in the box. The direction of pushing was determined by a flip of a coin, and as a result, 10 owners were asked to push the handle to the left with their left hand, and 7 to the right with their right hand. Ten such demonstration trials were performed.

Handle push group (N = 16; 11 males, 5 females; mean age = 4.10 years, SD = 2.65 years). The demonstration was the same as described above, but no ball emerged after the pushing action of the owner, and consequently no play followed any of the 10 demonstrations. The ball was positioned in the box so that it was not possible to make it roll out after pushing the handle. The owner stepped back 2 m after each pushing, turned the dog around, and covered its eyes while the experimenter placed the handle back into the original position. Twelve owners were asked to push the handle to the left with their left hand, and 4 to the right with their right hand. Ten such demonstration trials were performed.

Handle touch group (N = 16; 11 males, 5 females; mean age = 3.75 years, SD = 2.60 years). The sequence of actions was the same as above, but during the demonstrations the owner did not push the handle but only touched it with his or her forefinger. No ball emerged after the action, and consequently no play followed the demonstrations. The owner stepped back 2 m after each touching, turned the dog around, and covered its eyes. During demonstrations, the ball was in the box. Ten such demonstrations took place.

Top touch group (N = 19; 11 males, 8 females; mean age = 3.53 years, SD = 2.88 years). The sequence of the actions was the same as in the handle push group, but dogs witnessed their owner touching the top of the box. The ball did not emerge, so there was no play. After each demonstration, the owner stepped back 2 m, turned the dog around, and covered its eyes while the experimenter went to the box and touched it. During demonstrations, the ball was placed in the box. Ten demonstrations took place.

No touch group (N = 19; 12 males, 7 females; mean age = 4.47 years, SD = 2.74 years). Owners did not touch the box containing the ball but only played with their dogs with the ball in the vicinity of the box for 3 min, which was the average time of the demonstrations. There were 10 repetitions for each dog.

Phase 3: Test

The test phase consisted of three identical trials for all groups. At the beginning of the testing trials, the owner was asked to cover the dog's eyes with his or her hand while the experimenter placed the ball in the box. The ball rolled out when either the handle was pushed or the box itself was knocked or pushed strongly. In these trials, the dog had to solve the ball-getting problem alone; owners were allowed only to encourage their dog verbally from a distance of 1.5 m. They were allowed to say anything to their dog (e.g., "Where is the ball?," "Retrieve the ball to me!," "Look for the ball!," and "Good boy, well done!") but were prohibited from approaching the box. The trial was terminated after 60 s elapsed or if the dog got the ball. In the latter case, the owner and the dog played with the ball for 30 s, and then the owner covered the dog's eyes with his or her hand and gave the ball to the experimenter, who placed the ball in the box. If the dog was not able to release the ball from the box, there was no play.

Behavior Categories

The test trials were videotaped, and the following parameters were analyzed:

1. Latency of getting the ball (in seconds)—The time elapsed from the first touching of the box until the ball rolled out. If the dog did not get the ball during the test trial, it was assigned a latency of 60 s.

2. Latency of touching the different parts of the box—The time elapsed from the first touching of the box until touching the following named parts of the box: the handle (in seconds), the side of the box (in seconds), and the top of the box (in seconds).

3. Number of contacts with the following different parts of the box: contact with all parts of the box, contact with the handle, contact with the side of the box, and contact with the top of the box.

4. Duration of verbal encouragement of the owner toward the dog was also measured beginning after the dog first contacted the box until the emergence of the ball.

5. First part of the box touched—handle, side, or top.

6. Effective handle use—A dog received a score of 1 if it got the ball by using the handle in a trial. The results of the three trials were summed; therefore, the maximum score was 3, and the minimum score was 0.

7. Loyalty to the first effective action—A dog received a score of 1 if in Trial 2 or Trial 3 it pushed the same part of the box for getting the ball as in the first trial and -1 if it pushed any other part. Therefore, a dog that pushed the same part in Trial 2 and Trial 3 as in Trial 1 got the maximum score ($1 + 1 = 2$), but if it pushed other parts in the two consecutive trials, it got the minimum score ($-1 + -1 = -2$).

8. Direction of pushing the handle—A dog received a score of 1 if the handle was pushed to the right and -1 if it was pushed to the left. Therefore, the maximum score was 3, and the minimum score was -3.

One trained observer (Enikő Kubinyi) analyzed the whole sample using the behavior categories mentioned here. To measure the reliability of the behavior coding, a second trained observer—who was blind to which demonstrations each subject had seen—was also involved in the behavior analysis. Interobserver agreement was assessed for all the behavior variables by means of parallel coding of 25% of the total videotaped sample ($N = 21$ altogether). The sample equally represented all five groups. We assessed coders' agreement in three ways: Spearman correlation coefficient, percentage agreement, and Cohen's kappa, a statistic that corrects for chance agreement (Martin & Bateson, 1993). Spearman correlation coefficients were calculated for latency, contact, and duration of verbal encouragement variables. Percentage agreement and kappa coefficients were calculated after answering the questions "Which part of the box was touched first?," "Which part of the box was touched last?," and "Which direction was the handle pushed to?"

Analysis of Data

For statistical analysis, we used nonparametric tests because variables were not normally distributed (SPSS for Windows, Version 9.0). A within-group analysis by the Friedman test showed that the repeated trials (1–3) had no significant effect on the behavior of the dogs. Therefore, test trials were individually pooled for each group, and for all individuals, average values were calculated from the data of the three trials. Exceptions to this were scores of the first part of the box touched, effective handle use, loyalty to the first effective action, and direction of pushing the handle, for which averages were not calculated.

Kruskal–Wallis tests with Dunn post hoc tests were applied for comparison of the latency, contact, effective handle use, and duration of verbal encouragement variables of the experimental groups. Loyalty to the first effective action and direction of pushing the handle were analyzed by one-sample Wilcoxon matched paired signed-ranks tests, with a score of 0 as a hypothetical median.

The distributions of the first part of the box touched were analyzed by chi-square tests for goodness of fit between the groups. The no touch group was used as the expected distribution to which all other groups were compared.

Results

During the test trials, the dogs from all the groups readily manipulated the box, and most of them were successful in getting the ball. Only 1 dog in the handle push group and 1 in the no touch group could not acquire the ball at all during the three trials.

Remarkably, in the handle push plus ball group, the majority of the dogs (76.5%) touched the handle in all three trials, and no dogs did not touch it at all during the three trials. On the contrary, in the no touch group, only 3 dogs out of 19 (15.8%) touched the handle in all three trials, and 52.6% did not touch it at all. Consequently, six times as many dogs got the ball by the handle in each trial in the handle push plus ball group (64.7%) as in the no touch group (10.5%). In the latter group, there were only 2 dogs out of 19 who got the ball by pushing the handle in all three trials, in strong contrast to the handle push plus ball group, in which 11 dogs out of 17 used the handle as the means for getting the ball in every trial. The remaining three groups seem to form a transition between these two groups (see Table 1).

Table 1
Percentages of Dogs for Three Behavioral Variables

	No. of contacts with the handle				Effective handle use[a]				Loyalty to the first effective action[b]		
Group	0	> 0 in 1 trial	> 0 in 2 trials	> 0 in 3 trials	0	1	2	3	−2	0	2
Handle push + ball	0	5.9	17.6	76.5	0	0	35.3	64.7	0	35.3	64.7
Handle push	6.3	12.5	31.3	50.0	18.8	12.5	25.0	43.7	18.8	18.8	62.5
Handle touch	18.8	18.8	31.3	31.3	18.8	18.8	56.3	6.3	25.0	68.8	6.3
Top touch	36.8	26.3	15.8	21.1	36.8	31.6	15.8	15.8	42.1	21.0	36.8
No touch	52.6	15.8	15.8	15.8	57.9	21.1	5.3	15.8	0	36.8	63.2

[a] A dog received a score of 1 if it got the ball by using the handle in a trial. The results of the three trials were summed; therefore, the maximum score is 3, and the minimum score is 0. [b] A dog received a score of 1 if in Trial 2 or Trial 3 it pushed the same part of the box for getting the ball as in the first trial and -1 if it pushed any other part. Therefore, a dog that pushed the same part in Trials 2 and 3 as in Trial 1 got the maximum score ($1 + 1 = 2$), but if it pushed other parts in the two consecutive trials, it got the minimum score ($-1 + -1 = -2$).

First Part of the Box Touched in the First Trial and Effective Handle Use

Comparisons of the percentages of dogs contacting the box by one of the three possible actions (touching the handle, the side, or the top of the box) showed a significant difference in the first trial between the no touch group and all other groups: handle push plus ball, $\chi^2(2, N = 36) = 76.47$, $p < .01$; handle push, $\chi^2(2, N = 35) = 71.12$, $p < .01$; handle touch, $\chi^2(2, N = 35) = 20.76$, $p <. 01$; top touch, $\chi^2(2, N = 38) = 37.76$, $p < .01$ (see Figure 2).

As a possible result of the preferable handle touching, dogs in the handle push plus ball and handle push groups got the ball with the handle in the majority of the trials, whereas the no touch group used other means. However, the effect of the demonstration was stronger in the handle push plus ball group because this group also differed significantly from the handle touch and the top touch groups (effective handle use; Kruskal–Wallis with Dunn post hoc test, $H = 30.374$, $p < .01$; see Figure 3).

Latencies

It is interesting to note that in all groups dogs got the ball with the same latency if the type of action is not taken into account ($H = 4.129$, $p = .40$). In contrast, as Figure 4 shows, the type of demonstration influenced the latency of touching the handle because dogs witnessing the pushing of the handle (handle push plus ball and handle push groups) tended to manipulate the handle sooner than the dogs in the no touch group. The former differed also in the same way from the top touch group, but no differences could be detected in comparison with the handle touch group ($H = 24.124$, $p < .01$). Dogs in the handle push plus ball group were slower in touching the side of the box than were dogs in the no touch group ($H = 11.544$, $p = .02$). Additionally, the top touch group did not touch the top of the box sooner than did the other groups ($H = 6.399$, $p = .17$).

Contacts

Dunn post hoc tests did not show differences among the groups in the number of contacts with the box (all contacts, $H = 10.442$, $p = .03$). However, there were differences according to the parts of the box that were contacted. Groups differed significantly in the number of dogs touching the handle ($H = 20.895$, $p < .01$). Dogs witnessing a demonstration that was followed by the emergence of the ball (handle push plus ball group) tended to manipulate the handle more than did dogs in the no touch group. Because they focused on the handle, dogs in the handle push plus ball group made significantly less contact with the side of the box than did dogs in the handle touch, top touch, and no touch groups. The handle push and handle touch groups also differed in this way ($H = 20.288$, $p < .01$). There were no such differences in the number contacts with the top of the box ($H = 7.201$, $p = .13$).

Loyalty to the First Effective Action

Dogs were loyal to their first effective method in the handle push plus ball and no touch groups but not in the remaining groups. Figures 2 and 3 and Table 1 clearly indicate that the means for getting the ball were very different in the case of the former groups: The handle push plus ball group pushed preferentially the handle in contrast to the no touch group, in which dogs pushed the side of the box (Wilcoxon matched paired signed-ranks test, for the handle push plus ball group, $Z = -3.3$, $p < .01$; for the no touch group, $Z = -3.5$, $p < .01$; chance level = 0; see Figure 5).

Effect of Verbal Encouragement

Owners gave the same amount of verbal encouragement to their dogs in each of the groups, as the comparison of utterance durations showed no significant differences among different groups ($H = 6.588$, $p = .12$).

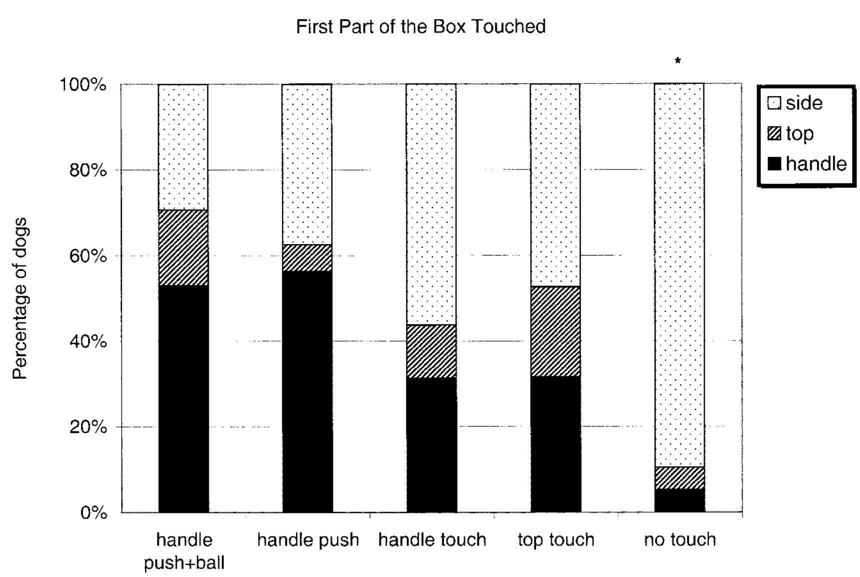

Figure 2. Percentage of the dogs making the first contact with the side, top, or handle of the box during the first trial. All groups differed from the no touch group. A chi-square test was used for goodness of fit, and expected values were the data of the no touch group. *$p < .01$.

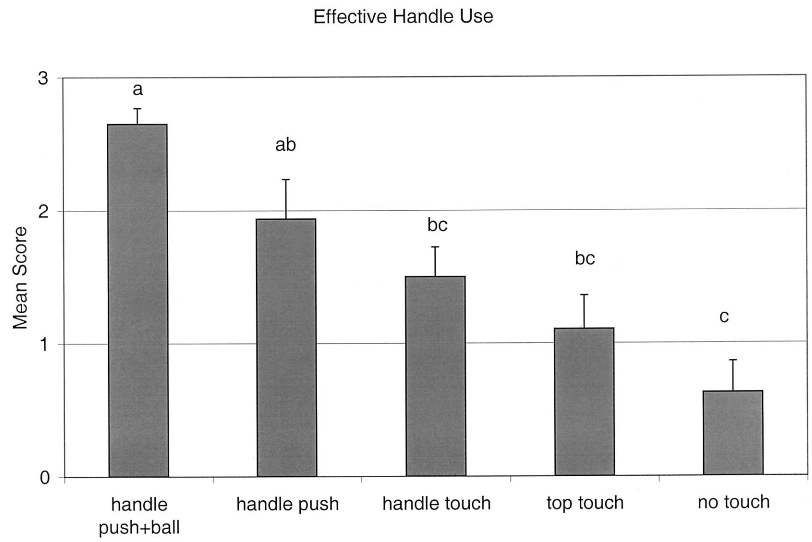

Figure 3. Mean effective handle-pushing scores during the three trials. The handle push plus ball group and the handle push group got the ball using the handle, whereas the no touch group used other means. The handle push plus ball group differed also from the handle touch and top touch groups. A dog received a score of 1 if it got the ball by using the handle in a trial. The results of the three trials were summed; therefore, the maximum score was 3, and the minimum score was 0. Error bars represent standard errors. Significant differences between the groups are indicated with different letters (Kruskal–Wallis with Dunn post hoc test, $p < .01$).

Direction of Pushing the Handle

Dogs not observing handle pushing did not prefer either direction (handle touch, $Z = -1.7$, $p = .09$; top touch, $Z = -1.6$, $p = .12$; no touch, $Z = -1.5$, $p = .13$). Dogs that saw a left-pushing demonstration in the handle push plus ball group (10 out of 17 dogs) did not prefer to push the handle to the left ($Z = -1.4$, $p = .11$). The same was true for dogs in the handle push group that saw a left-pushing demonstration (12 out of 16 dogs; $Z = -1.5$, $p = .65$). Similarly, dogs witnessing the opposite demonstration in both groups did not differ from 0 in their handle-pushing score (handle push plus ball, right demonstration, $Z = -0.7$, $p = .52$; handle push, right demonstration, $Z = -0.8$, $p = .41$).

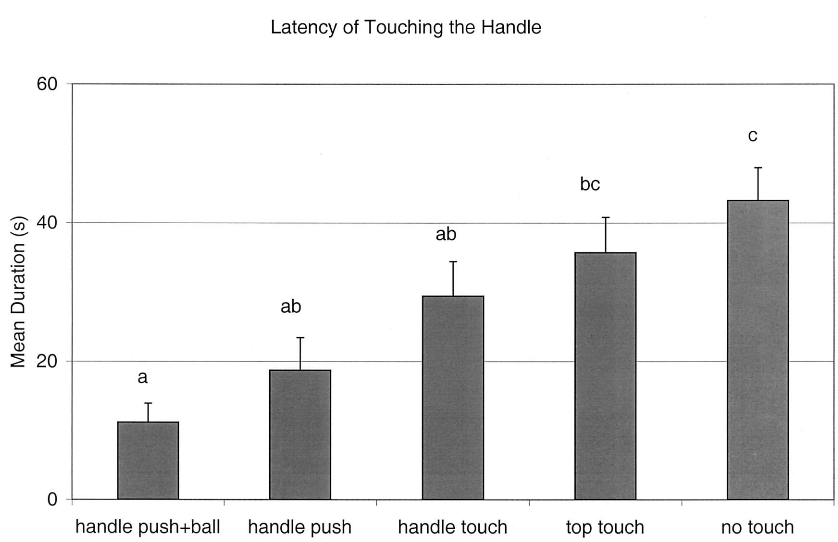

Figure 4. Mean latencies (in seconds) of touching the handle of the box during the averaged three trials. The latency was minor in the groups that witnessed handle demonstration (handle push plus ball and handle push groups) compared with the no touch group. The handle push plus ball group also differed from the top touch group. Error bars represent standard errors. The groups with significantly different latencies are indicated with different letters (Kruskal–Wallis with Dunn post hoc test, $p < .01$).

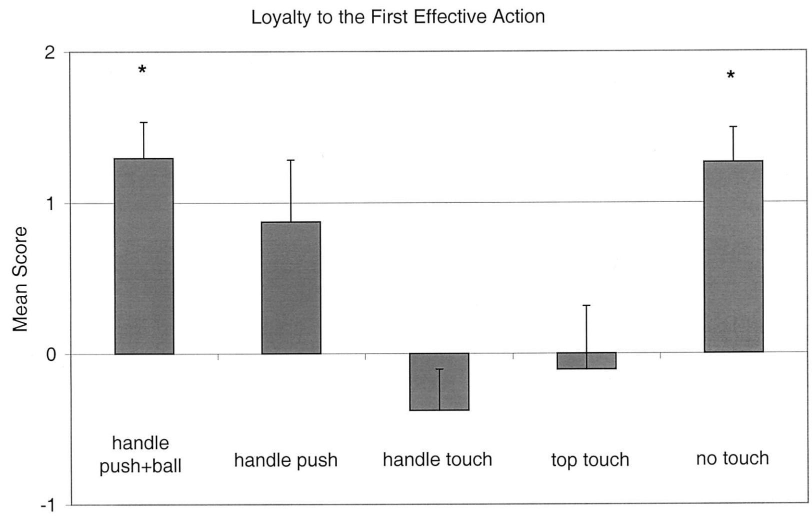

Figure 5. Mean loyalty to the first effective action scores in the two consecutive trials. The handle push plus ball group and the no touch group were faithful to their first used means in getting the ball; however, these means were not the same (see Figure 2). A dog received a score of 1 if in Trial 2 or Trial 3 it pushed the same part of the box for getting the ball as in the first trial and −1 if it pushed any other part. Therefore, a dog that pushed the same part in Trial 2 and Trial 3 as in Trial 1 got the maximum score (1 + 1 = 2), but if it pushed other parts in the two consecutive trials, it got the minimum score (−1 + −1 = −2). Chance performance level = 0. Error bars represent standard errors. $^*p < .01$ (Wilcoxon matched paired signed-ranks test).

Interobserver Reliability

In a convincing majority of the cases, coders agreed on which part of the box was touched first and last. Agreement was 90.5% for the first and 98.4% for the last part of the box touched. There were three possibilities for both the first and the last actions: touching the handle, side, or top of the box. Therefore, three kappa coefficients were calculated for the first part of the box that was touched (handle, $\kappa = .79$; side, $\kappa = .80$; and top, $\kappa = .91$), and three kappa coefficients were calculated for the last part of the box that was touched (handle [effective handle use], $\kappa = .97$; side, $\kappa = .97$; and top, $\kappa = 1$). Spearman correlation coefficients for the remaining variables are as follows: latency of getting the ball, $r_s = .942$; latency of touching the handle, $r_s = .987$; latency of touching the side, $r_s = .876$; latency of touching the top, $r_s = .772$; number of contacts with the handle, $r_s = .942$; number of contacts with the side, $r_s = .905$; number of contacts with the top, $r_s = .742$; and duration of verbal encouragement, $r_s = .91$.

Discussion

In this article, we have demonstrated the effect of human tutoring on dogs' ability to learn a ball-getting technique via observation. The significant differences between the groups of dogs that observed handle-pushing demonstrations (handle push plus ball and handle push) and the other groups (handle touch, top touch, and no touch) showed that owners are efficient demonstrators. Different manipulation techniques were equally suited to lead to the release of the ball because dogs got the ball with similar latency. Nevertheless, dogs witnessing the handle-pushing demonstrations touched the handle sooner and more often than dogs that did not see the owner pushing the handle. They also acquired the ball preferentially by pushing the handle.

To reveal a plausible mechanism for this case of social learning in dogs, we follow Zentall and Akins's (2001, Imitation section) considerations, in which an analysis is offered to avoid misinterpretations in social-learning studies. According to these considerations, one should control, first, for motivational effects on the observer produced either by the mere presence of the demonstrator or by the mere consequences of the behavior of the demonstrator. Second, one should control for the possibility that the demonstrator's manipulation of an object merely draws the observer's attention to that object. Third, one should control for the simple pairing of a novel stimulus with the presentation of inaccessible food (i.e., reward).

Here we controlled first both types of motivational effect because there was no demonstrator present in the no touch group and demonstration had no consequences in the handle touch, handle push, and top touch groups. Motivational levels in dogs assigned to the different groups to get the ball were comparable because, according to the outcomes of our pretesting, only dogs that reliably retrieved a ball were included. Moreover, during the testing, dogs showed similar latency to get the ball, suggesting that they were similarly motivated to manipulate the box.

Second, several groups were designed to control for the effect of the demonstrator's manipulation. We controlled for pairing the handle pushing with the reinforcer (handle push plus ball vs. handle push) and tested the saliency of the demonstrated action (handle push, handle touch, and top touch).

Third, because there was no outcome of the demonstration in three groups (handle push, handle touch, and top touch), we cannot talk about a real presentation of the reward. Therefore, pairing the ball with the demonstrated action is not likely in these cases.

Further, the effect observed cannot be explained by odor cues or involvement of the owner because the owner touched the handle for 30 s during Phase 1 in each case and we found no significant differences in any of the behavior variables between the handle touch and no touch groups. Although in the case of the former, the handle was touched 10 times by the owner just before the testing. The verbal encouragement offered by the owner did not differ among the groups either. This fact suggests that the owners encouraged their dogs regardless of their own behavioral actions during the demonstration trials (i.e., regardless of which group the dogs belonged). In summary, we conclude that some form of social transmission provides the most likely explanation for the effect observed.

When social transmission takes place between a demonstrator and an observer, there are several underlying factors that may contribute to this process: first, the observation of the motor pattern demonstrated; second, recognition of the goal of the observed action; and third, the salience of the stimuli relevant to that action. In this study, we tried to control for these effects by using different experimental groups, and therefore, the comparison of the five experimental groups offers us the possibility of characterizing the process that has taken place during observations. In the no touch group, demonstrations (playing with a ball) provided information only about the possible outcome of the situation. The handle touch and top touch demonstrations brought the dogs' attention to various parts of the box without any outcome. In a similar manner, handle push demonstrations increased the salience of the handle by the pushing action performed on it. Finally, the handle push plus ball demonstrations showed the relevant action followed by reinforcement (playing with the ball that rolled out).

In most of our behavior variables, we found that dogs witnessing the owners' pushing actions differed from the dogs in the handle touch, top touch, and no touch groups. With this in mind, the most probable suggestion would be that stimulus enhancement could explain our observations; that is, the pushing action of the owner enhances the saliency of the handle that in turn results in an increased tendency to get in contact with this object in observer dogs. Dogs did not copy the direction of action on the handle; therefore, imitative learning seems to be unlikely. However, one could argue that dogs learned not only about the importance of the handle but also about the action itself. The differences between the handle touch group and both other groups in which the handle was actually pushed (handle push plus ball and handle push) suggest that the pushing movement of the handle had a significant effect on the behavior of the dogs. Drawing the attention of the observer dog to the handle by tapping it only was not enough to increase the pushing performance in dogs. In agreement with this finding, chimpanzees find the directionality of manipulated objects (an object is directed toward another external location) a more salient cue than details of the demonstrator's body movements while performing the manipulation (Myowa-Yamakosi & Matsuzawa, 1999).

Most of the dogs used their nose to displace the handle, an action that was physically very different from that of the owners' (pushing with the hand). Because dogs readily use their noses for exerting physical force on objects, it is not clear whether dogs tried to mimic the handle pushing by using an action that resulted in the displacement of the handle. In this case, the actual behavior of the dog would be independent of the action performed by the owner and would be the result of the "understanding" that some action on the handle leads to its displacement. It is also likely that the dogs' actions on the handle were constrained by their species-specific behavior. Similar observations have been obtained with geese (see the introduction) that were exposed to human demonstration (Fritz et al., 2000): The birds used their beaks to copy the action performed by the human using his hand.

Some argue that faithful copying of an action (blind imitation; R. W. Byrne, personal communication, August 18, 2001) is more likely to occur if the observer does not "understand" the task at hand (Huber, 1998; Voelkl & Huber, 2000). In our case, even dogs in the handle push plus ball group had little chance of understanding how the box was working—especially at the beginning because they needed some time to realize that pushing the handle resulted in the appearance of the ball at the opposite side of the box. Behavioral similarity between the handle push plus ball group and the handle push group (in which demonstration did not result the emergence of the reward) underlines the assumptions that goal emulation (Huber, Rechberger, & Taborsky, 2001) cannot be involved in explaining the results. However, imitation also has to be rejected as a possible explanation because dogs did not prefer the direction presented by the demonstrator to push the handle. A more sophisticated apparatus, such as the artificial fruit presented by Whiten et al. (1996) and Custance et al. (1999), could be a more appropriate device to induce imitative behavior. In the studies mentioned above, three principal components could be removed in two alternative ways: Both chimpanzees (Whiten et al., 1996) and capuchin monkeys (Custance et al., 1999) reproduced the alternative techniques used for opening one component of the task but not the other two. It is suggested that chance slippages between alternative actions are more likely to be maintained if the two alternatives are not mutually exclusive. Although pushing the handle either to the right or to the left was mutually exclusive in our experiment, it did not turn out to be salient enough for the dogs. While exploring, dogs sniffing the handle easily pushed it with their nose. Similarly, most chimpanzees started to pull the device out, regardless of whether they had watched a demonstrator turn or pull (Whiten et al., 1996). Therefore, it can be concluded that the test was not suitable enough to encourage a clear choice between the two actions (Dawson & Foss, 1965).

Pongrácz et al. (2001) have reported similar observations. Dogs in a detour task did not copy the exact path of the human demonstrator, but they easily adopted the detour behavior shown by humans.

We should also emphasize that although we did not find major differences, the effect of the demonstration was more pronounced in the handle push plus ball group than in the handle push group. The demonstration without the emerging of the ball weakened the dogs' tendencies to get the ball by the same technique in the consecutive trials. Dogs in the handle push plus ball group had a more persistent preference for using the handle in the consecutive trials (high loyalty score) than did dogs in the handle push group. Although the latter also had this tendency, it did not differ significantly from the by-chance level. It is important to note that dogs without any demonstration seemed also to be faithful to their first action in the two consecutive trials, suggesting that dogs are originally faithful to their own invented methods but can be "confused" by an "irrelevant" human demonstration. In the study by Pongrácz et al. (2001), dogs remained faithful to their first direction of choice in subsequent detour trials even if the two alternatives were always available to them.

One interesting point of our study is that visible presence or absence of a reinforcement during demonstrations does not seem to play a major role because getting the reinforcer only slightly elevated the handle-using performance. We could not show any behavioral differences between dogs exposed to handle-pushing demonstrations either with or without a ball, except less loyalty to handle using in the latter. However, the role of the ball was considerably unusual in the presented situation. In the test phase, after the "Look for the ball!" instruction, all dogs showed searching behavior and started to observe the box very soon. Therefore, even dogs without any box-manipulating demonstrations were motivated to find a ball. Additionally, we cannot exclude the odor effect of the ball because it was placed in the box during all demonstrational phases. The only significant difference between the handle push plus ball group and the other groups was that in the former the ball acted as a causal factor (i.e., pushing the handle was followed by the emergence of the ball). It should be noted that in this experiment social learning did not convey a benefit with regards to the efficiency with which an organism solved a problem. Every group showed similar latencies to solution. This is important because others have found (i.e., Palameta & Lefebvre, 1985) that the observation of the reward gained by the demonstrator is an important factor for social learning to take place in other species (Heyes, 1994). This result further supports the claim that dogs picked up special abilities for being in close relation to humans during domestication.

Dogs could have been selected for an enhanced willingness to attend to the behavioral actions of humans, even in cases in which the goal or the result of the action is not clear. This ability also emerges in human development (e.g., Meltzoff, 1996), but this does not exclude the possibility that other animals might show spontaneous copying of other's actions under special circumstances (see Goodall, 1986; Moore, 1992; Russon & Galdikas, 1993, 1995; Tayler & Saayman, 1973). Because most dogs spend their entire lives in human social groups, the acquisition of socially transmitted information might have a pronounced importance. We suppose that the ability to learn via observation contributes to a great extent to the dog's successful integration into the human family. Davey (1981) suggests that learning by observation is a means to facilitate social cohesiveness.

We conclude that the owner is an efficient demonstrator for the dog. The results of this study are best interpreted in terms of stimulus enhancement: The dog's attention is focused on one particular part of the box (the handle), and at the same time, the dog is inclined to use an action that is part of its behavioral repertoire. Dogs proved to be very flexible in social learning because they are able to learn from other species (humans) and without food or any other causal reinforcer. Nevertheless, the limitation of the present experimental procedure might have hindered finding more convincingly complex phenomena of social learning in dogs.

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Appendix

Breeds of the Participating Dogs

Handle push plus ball group: Belgian shepherd (5), German shepherd (3), Hungarian vizsla (2), kerry blue terrier (1), border collie (1), German pointer (1), Transylvanian hound (1), great schnauzer (1), mudi (1), mongrel (1).

Handle push group: Belgian shepherd (8), German shepherd (2), German pointer (1), dobermann (1), boxer (1), Welsh terrier (1), sheltie (1), mongrel (1).

Handle touch group: German shepherd (5), Belgian shepherd (4), golden retriever (2), border collie (2), mid schnauzer (1), fox terrier (1), mongrel (1).

Top touch group: German shepherd (5), Belgian shepherd (4), Hungarian vizsla (1), briard (1), great dane (1), great schnauzer (1), golden retriever (1), Alaskan malamute (1), border collie (1), mudi (1), cocker spaniel (1), boxer (1).

No touch group: Belgian shepherd (10), mongrel (4), German shepherd (1), border collie (1), German pointer (1), mudi (1), pumi (1).

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