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SHORT COMMUNICATION

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Social mimetic behaviour and social anticipation in dogs: preliminary results

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Abstract Learning contributes to the development of mutual mimicry in group mates. The aim of our study was to investigate whether dogs would initiate walking a detour if they were repeatedly exposed to the detouring behaviour of their owner. Eight dog owners were asked to modify their usual way of approaching their home at the end of their daily walks, namely, to make a short detour before the entrance. Owners performed the detour at least 180 times, over a period of 3-6 months. During the first 30 detours (trials 1-30) all dogs followed the owner on the new route. Between trials 151 and 180, four dogs started to walk the detour before the owner displayed any intention to walk in that direction in 50-93% of the cases. Further observations that were carried out on one dog showed that the initialisation of the detours manifested sooner if a second familiar person started to walk the detours. Interestingly, the dog persisted in initialising detours long after the owners stopped detouring. We describe the observed phenomenon in the framework of social anticipation that manifests when an animal learns the proper sequence of an act performed by another animal, so that it can (1) predict the action in this sequence, and (2) as a result start either a similar or a complementary action as a response. These observations suggest that the dogs' social anticipation ability contributes to behavioural synchronisation and cooperative processes between dog and owner.

Keywords Social mimesis Habit learning · Social anticipation · Domestication Dog

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Introduction

Activities of social animals often appear highly coordinated, with group members performing the same or a corresponding behaviour approximately at the same time. This type of mutual mimicry that makes everyday group life `easy going' was described as allelomimetic behaviour by Scott (1945). Many authors (e.g. Galef 1988) subsequently described similar mimetic processes by using different terms (e.g. social enhancement: `a generic to refer to all social influences on performance of established responses', Galef 1988, p. 13) and later Whiten and Ham (1992) summarised these phenomena as forms of social influence. In this process, the behavioural `mimicry depends on some social influence of A on B, without B actually acquiring from A the information underlying the resemblance' (Whiten and Ham 1992, p. 252).

It has rarely been mentioned that an important aspect of learning is to recognise the sequential nature of social behaviour patterns. Social behaviour patterns are often pictured in static form but in reality the temporal component is also important. A `threat' or a `greeting' should not be imagined as a static body posture but as a sequence of many, more subtle, behavioural actions. To react in an appropriate manner and with appropriate timing the individuals need to be able to recognise the behaviour sequence of their group mates. This knowledge can only be gained by direct experience with other group members (Galef 1988; Caro and Hauser 1992) as deprivation experiments have clearly shown in highly socialised mammals such as monkeys (Harlow and Harlow 1962) and wolves (Ginsburg 1975). Under natural conditions this process takes place relatively unnoticed during the development of the offspring. Similar behavioural mechanisms result in the ability of group members to synchronise their activities to take joint actions, for example, to prepare for hunting (see, for example, Fox 1980).

Everyday social life offers many situations in which both anticipation (`deduction' of the other's future actions from observing its preceding behavioural sequences) and matching (performing in advance appropriate behavioural

manoeuvres) are necessary. As noted above, we think this process constitutes a special form of social influence (Whiten and Ham 1992), where one individual A acquires some information about the XYZ behavioural sequence performed by B. For this learning to occur, A has to observe the XYZ sequence repeatedly over time, which supposes that B performs the XYZ sequence regularly. The information gained by A can be used for directing its own behaviour and executing appropriate behavioural actions before, at, or after the end of the XYZ sequence. For example, a submissive animal can learn to inhibit the emergence of full blown threats of a dominant by starting to show the submissive behaviour pattern before the end of the threat sequence. In cooperative situations the endpoint of actions of one individual can be anticipated by others, and appropriate actions can be taken to allow smooth progress of the joint action. This kind of social anticipation can only take place in groups where there is individual recognition among group members, and where continuous interaction among group members in many activities (cooperative hunting, food sharing) ensures sufficient experience.

The key difference between allelomimetic behaviour (Scott 1945; doing what others in the groups do) and social anticipation is that the latter is thought to involve some experience or learning by observing the behaviour of the other. This experience does not get amalgamated with the individuals' own behaviour; instead, it acts as a ‚releasing stimulus' for the appropriate (matching) behaviour to emerge.

In the current study we establish a social situation involving dogs and humans where the effect of social anticipation on behaviour can be tested. We have investigated whether dogs would initiate walking a detour or new route if they were repeatedly exposed to the detouring behaviour of their owner.

Study 1

Methods

Subjects

Observations were carried out on eight adult pet dogs (Table 1). The dogs were living in human families (Budapest, Hungary) and had joined their families as puppies at the age of 2 months, with the exception of Lili and Kflkusz, who were taken from dog shelters at the age of 2 years. Dogs were not neutered and did not receive any particular training previously; however, three of them (Bag6, Figura, Fines) passed a basic obedience exam with their owners.

The dog owners were young or middle-aged women (aged between 17 and 50 years), with the exception of the owner of Bosk6, who was a 22-year-old man. They volunteered to take part in this study after reading advertisements that had been placed at both the Campus of the Eötvös University and the Veterinary University in Budapest. The only precondition for taking part in this study was that the owners had to live in a flat and walk the dog regularly (at least once per day).

Procedure

The experimental trials were run in the surroundings of each dog owner's residence; only the dog and owner were present. Obviously, we had no control of the actual surroundings, but depending on the particular circumstances, the area chosen for the detour was either a fenced garden in front of the house entrance, or in the case of a building estate, the staircase of the building nearest to the flat entrance. By choosing a restricted area, we tried to minimise the effects of environmental stimuli that might have influenced the behaviour of the participants.

Experimental (detour) trials

Dog owners were asked not to enter their flat or house at the end of their dog walking but to make a short detour in front of the entrance. The length of this detour was between 16 and 20 m, and it took the owners 16-20 s to walk this route. These detours were always determined in such a way as to lead the owner (and the dog) away from the flat entrance (for an example see Fig. 1). Having approached the flat (house) entrance, the owner had to continue his/her walk, without any interruption, along this additional route. At halfway (approximately 8-10 m), the owner turned around and walked back on the same path to the flat (house) entrance.

Table 1 Summary table of the dogs

Name of dog	Breed	Gender	Age (years)	Walks/day	Walks by a second family member during Study 1
Lili	Hungarian vizsla	Female	5	3	163
Bosk6	Hungarian vizsla	Male	1	3-4	151
Bag6	Hungarian vizsla	Male	10	3	0
Figura	Kerry blue terrier	Male	5	3	0
Fogi	Terrier-like mongrel	Female	7	3	18
Angie	Shepherd-like mongrel	Female	4	2	145
Riles	Belgian shepherd	Female	4	3	13
Kflkusz	Labrador-like mongrel	Male	3	2	0

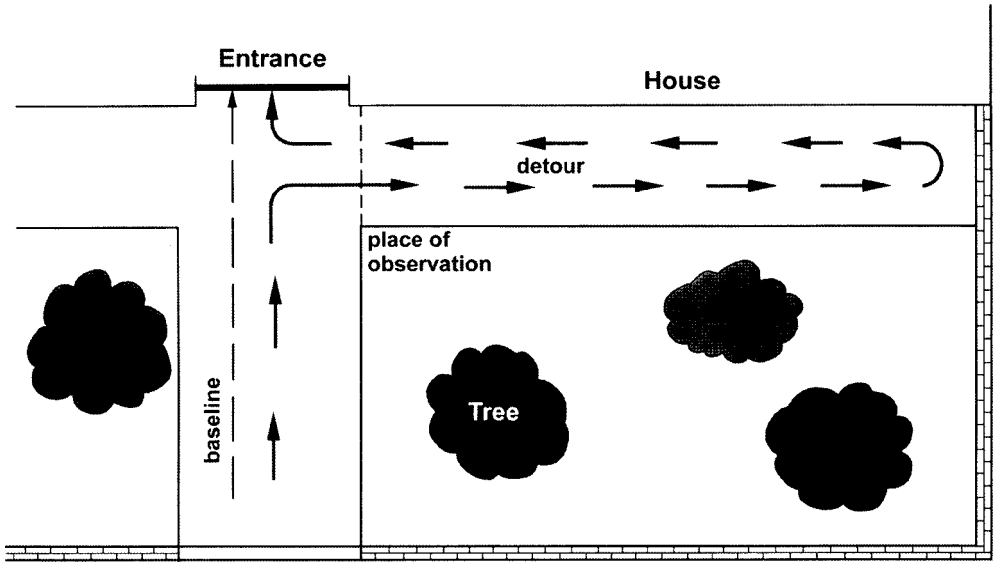

Fig. 1 A sketch of a detour trial based on the actual path walked by the owner of Kókusz

Before the start of the study, the experimenter met each owner and dog, determined the path of the detour, and obtained a verbal statement from the owner about the path the dog usually takes when approaching the entrance. The expected behaviour of the owner was then explained and demonstrated. Importantly, the owners were not told about the aim or the hypothesis concerning this study. The owner was asked to include these detours in his/her daily walks with the dog and from the beginning of the experiment the owner always had to walk along this path before entering the flat on at least 180 consecutive trials. Depending on the number of daily walks with the dog, owners completed this task in 3 to 6 months.

Owners were asked to walk their dog as usual, but for the duration of the detour it was forbidden to talk to, to look at, or to touch the dog. Owners were also forbidden to feed the dog during the detour or use other means of ‚reward', such as playing or smiling. If owners used a leash for walking the dog, they took it off before entering the experimental area.

Baseline trials

Before the experimental trials began, the owners were instructed to observe and note for 30 times the exact position of the dog in relation to their body (see "Behaviour categories", below), during their usual route to the flat entrance after the walks. During these trials the owners had to describe whether the dog went to the entrance of the flat in a straight line. Baseline trials were run to ensure that any subsequent change in the behaviour of the dogs during the following experimental trials could be related only to the owners' detouring. Owners completed this task in 2–4 weeks.

Control trials

To control for the effect of the change in the owner's behaviour during the detour trials, only one member of the family walked with the dog along the detour. Other members of the family (if they also walked the dog, see Table 1) were asked not to change their usual walking route. However, they were also trained to recognise the behavioural categories and had to report the dog's behaviour by taking notes on separate data sheets during the entire period of the experiment. Three dogs were walked by the owner only, so in those cases no control trials were possible.

Behaviour categories

The behaviour categories were based on pilot observations and describe the position of the dog relative to the owner at the time when the owner made his/her first step in the direction of the detour.

- Stopping. The dog stops (usually near the flat entrance) and does not follow the owner on the detour.
- Following. The dog walks behind the owner on the detour, that is, the dog's nose is 30 cm or more behind the owner's back.
- Escorting. The dog walks next to the owner with its shoulder approximately in line with the owner's body.
- Overtaking. The dog walks ahead of the owner; there is at least a 30-cm distance between the tail of the dog and the owner.

The position of the dog was observed by the owner and the respective category was marked on a prepared data sheet immediately after the trial. The recognition and coding of the categories was discussed and practised with the owners. The experimenter (E.K.) met the owners every week to check their notes and visited them every month to

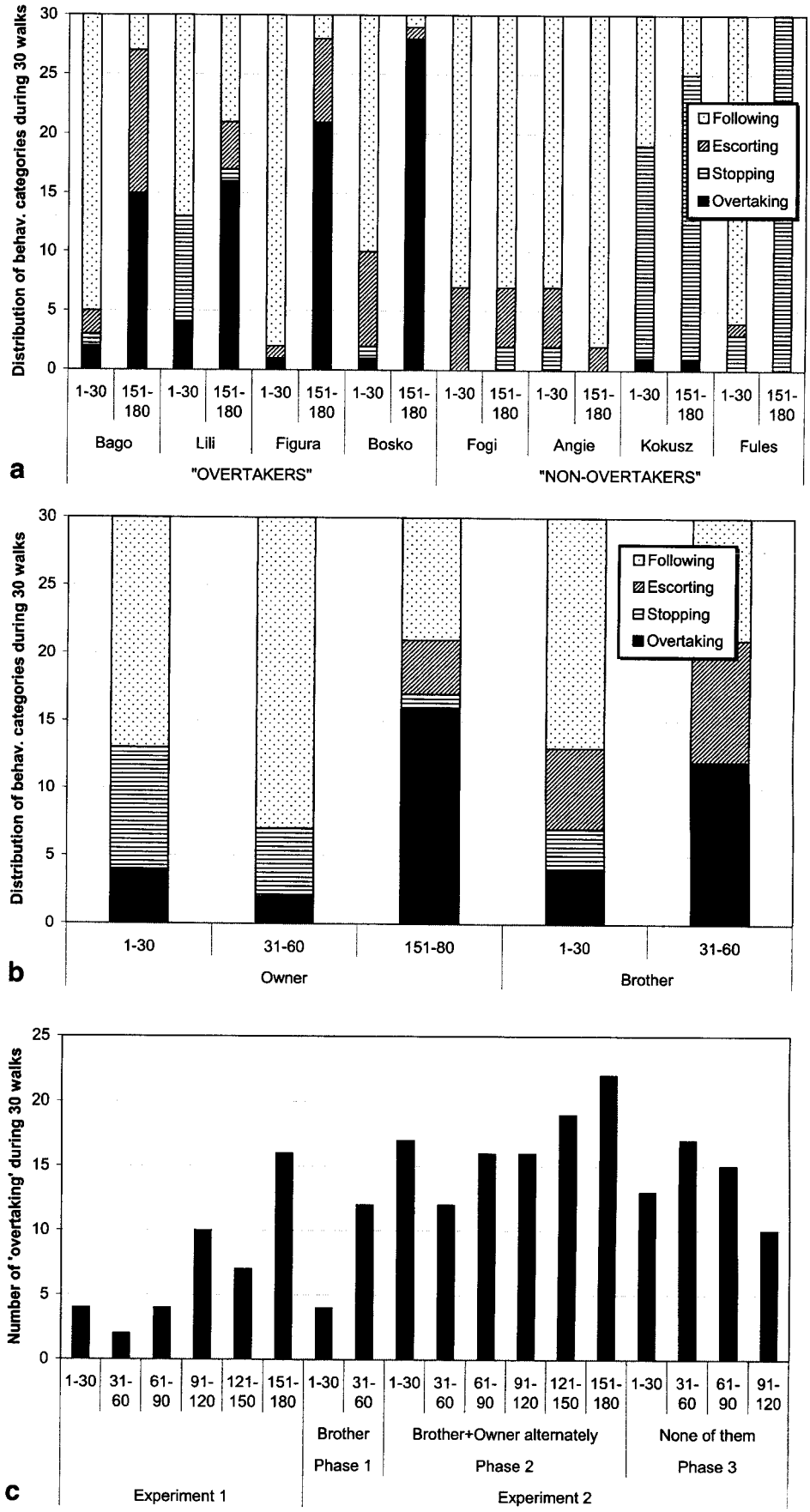

Fig. 2 a Occurrence of different types of actions during trials 1-30 and 151-180. the four dogs on the *left* developed the habit of `overtaking' the owner before he/she started to walk the detour (see text for statistical analysis). b Occurrence of different types of actions during trials 1-30, 31-60, and 151-180 with the first demonstrator (owner) and trials 1-30, 31-60 with the second demonstrator (brother; for statistical details see text). c The proportion of `overtaking' actions during the experiments in one dog. In phase 1 only the brother walked the detours, in phase 2 both demonstrators walked the detours, and in phase 3 the demonstrators have stopped walking the detour (for statistical details see text)

observe a detour. On none of these latter occasions did the experimenter find any discrepancies between her judgement and that of the owners'.

Data analysis

The changes in behaviour were analysed separately for each dog. We compared the proportions of the four behavioural categories between trials 1-30 and trials 151-180 with G-tests.

Results and discussion

Baseline and control trials

During the 30 baseline trials, dogs always went to the entrance of the flat (house) in a straight line with one exception each in the case of three dogs. Similarly, there was also no change in the behaviour of the dogs during the control trials, when they walked with other members of the family. In all cases, dogs approached the entrance along the shortest route and stopped at the entrance to the flat or house.

Experimental trials

During trials 1-30 the most frequent (mean±SE: 72.5± 18.5%) behaviour category was `following' the owner during the detours (Fig. 2a). Trials 151-180 differed significantly from trials 1-30 for five of the eight dogs (Figura: G=144.70; Bagó: G=90.72; Lili: G=28.52; Bosko: G=176.44; Fiiles: G=138.15; all P<0.005). For four of these dogs (Figura, Bagó, Lili, Bosko) the proportion of `following' decreased, with `overtaking' becoming more common. Two dogs that followed the owner in trials 1-30 did not show any change in their behaviour during the experiment; `following' was most frequent equally in trials 1-30 and trials 151-180 (Fogi: G=-3.36, P>0.1; Angie: G=7.02, P>0.05). The remaining two dogs (Kokusz, Fines) stopped at the entrance and waited for the owner to return during the last 30 trials. In summary, these results show that by observation and participation in a joint action, some dogs were able to start to initiate walking on a novel route that was introduced and performed repeatedly by their owner.

Study 2

Here we examined the amount of experience needed for the emergence of the same behaviour in the presence of a new demonstrator (another familiar person) in one dog. After the stabilisation of this behaviour, we observed the course of extinction, when all human companions that walked the dog ceased to walk the detour.

Methods

Subject

One day after the completion of study 1 we continued to observe one dog from the 'overtakers' group (Hungarian vizsla, Lili). During this experimental period the dog was walked by two family members (`owner' and `brother') alternately (each walk with the owner was followed by a walk with the brother).

Procedure

This study was divided into three distinct phases.

- Phase 1. The procedure was similar to that described in study 1 but the roles of the `owner' and `brother' were swapped. This time only the new demonstrator (`brother') walked the detours. The dog's behaviour was observed in 60 detour trials.
- Phase 2. Both the owner and the brother walked the detour alternately until the dog reached the criterion of ,overtaking' in at least eight walks out of ten over two consecutive 10-trial series.
- Phase 3. Both the owner and the brother ceased walking along the detour and returned to their usual route by going in a straight line to the flat entrance. The behaviour of the dog was observed for a further 140 trials (79 walks with the owner, 61 with the brother). Since in this phase of the study humans no longer made the detour, only the occurrence of `overtaking' was possible to note, when the dog's action preceded the action of its human companion.

Results and discussion

The results of phase 1 (Fig. 2b) suggest that in the case of another human companion, the dog passed more quickly through the stages of establishing the behaviour. Whereas trials 1-30 of this dog in study 1 (with the `owner') and in study 2 (with the `brother') did not differ from each other (G=-6.59, P>0.05), the second 30 trials (trials 31-60) showed a marked difference (G=26.11, P<0.01) that was mainly due to the earlier emergence of `overtaking' in study 2. The comparison of trials 151-180 in study 1 and trials 31-60 in study 2 showed no significant differences (G=2.37, P>0.1), that is, after 30 detours with the second demonstrator (the brother) the dog showed similar behaviour patterns as after 150 detours with the first demonstrator (owner).

In phase 2, the dog reached the criterion mentioned above in 180 walks (99 walks with owner and 81 with brother). In phase 3 there was a significant decline in the proportion of `overtaking' after the human companions stopped walking the detour (G=11.07, P<0.005) but even so the proportion of `overtaking' was significantly higher in trials 91-120, compared to that of trials 1-30 in study 1 (G=6.3, P<0.05) (Fig. 2c).

Our observations on this dog point to the robustness of this effect. `Overtaking' not only developed faster with a new human demonstrator (phase 1), but at the same time it also became quite resistant to `extinction' (phase 3), and the dog displayed it regularly (at a proportion of about 30%) relatively long after the human companion had ceased making the detour during walks.

General discussion

Our results show that on the basis of a joint action with their owner some dogs are able to change their behaviour in anticipation of the human's actions. This change is displayed only in the presence of the demonstrator and not in the company of other familiar persons, suggesting that it is probably associated with the individual human companion. Nevertheless, if the dog has the opportunity to acquire this behavioural change earlier, it will display the same action sooner when walking with a second demonstrator. This newly developed habit seems to be very resistant to extinction, even in the absence of the detouring behaviour of the demonstrators.

The emergence of the new action indicates that dogs are able to learn about a behavioural sequence performed by another individual, and at the same time they are inclined to adopt this behaviour themselves. However, if we suppose that the dog has acquired the habit of walking along the new detour as a result of social interaction, the contribution of learning to achieve social mimesis makes it difficult to fit the present phenomenon into the categories of social influence (Whiten and Ham 1992). In the case of contagion or social facilitation no explicit learning is involved because the behaviour of the conspecifics provides the necessary releasing stimulus for a species specific behaviour on the part of the observer (Thorpe 1963; Whiten and Ham 1992).

Copying of a behaviour that is already present in the behavioural repertoire of the animal has been termed 'response facilitation' (Byrne and Russon 1998). In this case the observation enhances the relative frequency of an act that is already in the repertoire of the animal. The only problem with this definition in our case is that, strictly speaking, `overtaking' has never been observed in the absence of the demonstrator because it can only be observed in relation to the demonstrator. However, this problem can be solved if one takes the first 30 detours as the baseline observation during which all would-be 'overtaker' dogs showed a few instances of this behaviour. In a related study we also found effects of response facilitation when dogs are given the opportunity to observe a human detouring around a fence (Pongrácz et al. 2001), since observer dogs are faster to get to the goal in comparison to the non-observer companions.

A similarly long incubation period (60-120 trials) led to behavioural conformity in an African grey parrot (Psittacus erithacus; Moore 1992). This bird was able to copy many motor actions (with some possibly novel motor components that had been indexed by vocal production) by observing a human performing them repeatedly. The author interpreted these results as being examples of imitation. Additionally, in Heyes's (1994) terms, topographically novel reproduction of a motor act(s) might also be viewed as a manifestation of imitation. Therefore in this study the dogs' performance might also be regarded as imitative (but see Whiten and Custance, 1996, for critical evaluation of the `novelty' concept in imitation).

By listing some possible categories to describe our observations, we only intended to emphasise that, despite the well-defined categories of social mimetic processes, it is often the case that the actual behaviours seem to evade easy categorisation. Therefore, we suggest the use of the term `social anticipation' to describe social processes of mimetic behaviour in which an animal has learnt the proper sequence of an act performed by another animal, so that it can (1) predict the action in this sequence, and (2) as a result, start either a similar or a complementary action as a response. The second condition is theoretically not necessary for the first to take place, but the manifestation of the learning process can only be deduced by observing any behavioural actions on the part of the observer that conform with the second condition. Social anticipation probably is most common in gregarious species or between parents and offspring, since it assumes stable and tight bonds among group members.

In the following we would like to examine the significance of this phenomenon in the social life of the dog. Slabbert and Rasa (1997) observed that dog pups could acquire information from their mother through observational learning. The interesting similarity between this and our study is that neither the observers nor the demonstrator received any extrinsic reinforcement during demonstration, the significance of which is often stressed in processes of social learning (e.g., Heyes 1994). In contrast, now we should recognise that there are other more subtle instances of social behaviour, where learning between individuals is necessary, but reinforcement of any kind plays a minor role (Mikl6si 1999).

In line with this, we should also stress the importance of the relationship between demonstrator and observer (Mikl6si 1999, Topál et al. 1997). For example, Russon and Galdikas (1995) argued that closer contact between demonstrators and observers not only makes observation easier but the observer is also more familiar with the general motor patterns of the demonstrator, and this can help him recognise significant changes in the demonstrator's behaviour.

The low number of dogs in the study prevents us from making strong generalisations about breed-specific differences. However, we know that dog breeds show specific genetic traits (Scott and Fuller 1965) and it is remarkable that all the gun dogs and the terrier proved to be 'overtakers', whereas the sheepdog and the mongrels were 'non-overtakers'. Gun dogs have been shaped for specific tasks (e.g. cooperative hunting with people) through selective breeding (Coren 1994). In theory, this could have affected both their relationship with humans and their affinity to adopt human habits.

Despite the limitations of the present experiment, it is well grounded that at least some dogs are able to show a previously non-described mimetic behaviour, or social anticipation. This ability-which might have been influenced by the process of domestication-enables the dog to evade the escalation of conflicts and attain high levels of behavioural synchronisation in its social group. In addition, it plays an important role in supporting the establishment of cooperative actions, contributing to a great extent to the ability of dogs to lead blind persons (Naderi et al. 2001) or assist disabled persons.

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