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Dogs and their human companions: The effect of familiarity on dog–human interactions

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ABSTRACT

There are few quantitative examinations of the extent to which dogs discriminate between familiar and unfamiliar persons. In our study we have investigated whether dogs show differential behaviour towards humans of different degrees of familiarity (owner, familiar person, unfamiliar person). Dogs and humans were observed in eight test situations: (1) *Three-way strange situation test*, (2) *Calling in from food*, (3) *Obedience test*, (4) *Walking away*, (5) *Threatening approach*, (6) *Playful interaction*, (7) *Food inhibition test* and (8) *Manipulation of the dog's body*.

Dogs distinguished between the owner and the two other test partners in those tests which involved separation from the owner (Test 1, 4), were aversive for the dog (Test 5) or involved playing interaction (Test 6). Our results revealed that the owner cannot be replaced by a familiar person in situations provoking elevated anxiety and fear.

In contrast, dogs did not discriminate between the owner and the familiar person in those tests that were based on obedient behaviour or behaviour towards an assertive person (Tests 2, 3, 7 and 8). Dogs' former training experience reduced the difference between their behaviour towards the owner and the familiar person in situations requiring obedience but it did not mask it totally. The dogs' behaviour towards each of the humans participating in the tests was consistent all over the test series.

In summary, dogs discriminated between their owner and the unfamiliar person and always preferred the owner to the unfamiliar person. However, the discrimination between the owner and the familiar person is context-specific.

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1. Introduction

Many dogs enjoy life in human families which presents a challenging social environment to them. Unlike their wild relatives, which live in relatively permanent social units, companion dogs may encounter frequently con- or hetero-specific beings which vary in familiarity. The development of tolerance towards unfamiliar or familiar people (and dogs) is one key factor in everyday dog socialisation and training. It is expected that dogs show tolerance towards humans and other dogs during walk, in dog play areas, and at dog training schools. This concept of 'friendliness'

('amicability') was exposed in several recent publications (e.g. [Ley et al., 2009](#)).

Nevertheless, there is relatively little information on how dogs behave towards humans who differ in familiarity. Social relationships based on familiarity can vary broadly, and may depend on the individual characteristics of the partners. In this paper we define 'familiarity with people' as the result of regular encounters of friendly nature with humans who are not member of the dog's social group. Such social relationships (e.g. owners' friend, grandmother, neighbour) with people may be particular for dogs living in human families.

Many investigations showed that dogs readily discriminate between their owners and (neutral or friendly) strangers however the magnitude of the effect is often context dependent. Companion dogs showed more attention towards their owner in spontaneous situation ([Mongillo et al., 2010](#)) or when the owner was pretending to search ([Horn et al., 2013b](#)). Dogs also reacted

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differently to the presence of the owner or a stranger in the so called 'Strange Situation Test' (Topál et al., 1998; Palmer and Custance, 2008; Palestrini et al., 2005; Prato-Previde et al., 2003). Dogs played and spent more time exploring the room in the presence of the owner, while they were standing for longer duration at the door in the absence of the owner. Dogs showed higher levels of contact seeking with a shorter delay towards the entering owner compared with the stranger, and in parallel they displayed more intensive greeting behaviour at reunion. These results were taken as evidence that dogs are able to form an individual specific attachment relationship with their owner that is analogue to the mother–infant attachment (for review see Topál and Gácsi, 2012).

Györi et al. (2010) compared the behaviour of dogs in playful and threatening situations when they were interacting either with the owner or a stranger. Most dogs were tolerant towards the owner in both contexts; the playful interaction observed between dogs and their owners or strangers was indistinguishable. In contrast, dogs showed clear signs of avoidance when they were facing a stranger in an agonistic situation. Dogs seemed to be less discriminative towards humans in another study on playing interactions (Tóth et al., 2008). In this experiment dogs participated in four play sessions: ball games and tugging games with a stranger or with the owner. In this case the dogs' behaviour was influenced by their motivation to play rather than the familiarity of the test partner. Similarly, the owner and a stranger were equally successful in influencing the choice behaviour of dogs searching for food (Marshall-Pescini et al., 2011).

Only a few studies investigated how dogs' behaviour may be affected by interactions with different members of the family. Horn et al. (2013a) aimed to discriminate between familiarity and ownership by including people who differed in the quality of their relationship. They found that dogs are more interested to watch the owner than the other familiar person. This study is important because it also emphasises the specific, individualised role of the owner in the dogs' life.

Although these studies described above are relatively new, there has been little methodological discussion about social context in which family dogs are tested in the laboratory. For example, dogs participating in personality testing were accompanied either by their owner or a familiar person (e.g. Svartberg, 2005). In the investigations reported by Max-Planck Institute for Evolutionary Anthropology (e.g. Scheider et al., 2011) dogs are routinely tested either in the absence of their owners or in the presence of a stranger (according to our characterisation above). Based on Horn et al. (2013a) one may hypothesise that the presence or absence of the owner and familiarity of the experimenter may affect the behaviour and performance of the dog.

The main aim of the present study is to provide further evidence on context-dependent discrimination among strangers, familiar persons and the owner in dogs. Earlier studies found that the owner–dog relationship is specific when compared to the dogs' attitude towards a friendly or neutral stranger. Here we wanted to see whether dogs showed similarly strong owner-preference in the presence of a familiar person (who was not a family member) with whom they also shared a rich social relationship.

In contrast to earlier investigations we compiled a test battery that represents a relatively broad range of interactions which may take place in experimental situations. Tests applied to the same dog population can be divided into two categories. In four test situations (Tests 1, 4, 5 and 6, see below) we investigated dogs' attachment behaviour (sensitivity to separation) and playful interaction with humans, and in the remaining four test situations (Tests 2, 3, 7 and 8) we observed the differences in obedience in the presence of the different persons.

2. Method

2.1. Subjects

Twenty dogs (10 males and 10 females of various breeds, age 3.1 ± 1.6 years (mean \pm SE)) took part in this study (for participants' data see Appendix). Dogs had various levels of training experience. All dogs participated in the tests with three human partners being present at the same time: the owner, a familiar woman, and an unfamiliar woman. Owners were volunteers chosen from the database of the Family Dog Project (<http://familydogproject.elte.hu>) or were recruited in dog training schools. The 'owner' by definition was the person who perceived herself as the owner of the dog. In a questionnaire (Kerepesi et al., manuscript in prep) we showed that the person, who considers her/himself to be the owner of the dog, is the same person to whom other family members attribute the ownership.

Human gender has also a significant effect on dog's behaviour (Wells and Hepper, 1999; Wormser, 2006) and male and female owners interact differently with their dogs (Prato-Previde et al., 2006), thus we decided to ask only women to participate in this study. The owners were asked to bring a female friend who acted as the familiar person in the tests. This person had to have regular contact with the owner, and at least bi-weekly contact of positive nature with the dog, but must not live in the same household. The persons playing the role of the unfamiliar woman had extensive experience in working with dogs. The unfamiliar person met the dog for the first time 20 min before starting the first test. In order to get familiar with the dog, she was allowed to stroke the dog and play with it in the presence of the owner during this period.

2.2. Test locations

Dogs were observed in eight behavioural tests organised into two sessions, and carried out on different days, with 1–6 weeks between the two occasions always in the same order. Four tests took place on the first day: (1) *Three-way strange situation test*, (2) *Call-in from food*, (3) *Obedience test*, and (4) *Walking away*.

The first two tests took place in a $3\text{ m} \times 5\text{ m}$ room in the university building, at a place which had never been visited by the dog before. The experimental room had three doors, leading in three different directions. Two cameras were located at the two sides of the room, opposite to each other. The *Obedience test* and the *Walking test* took place in open field next to the university building, which had not been visited by the dog earlier. An unfamiliar location was chosen to provoke more apparent reaction from the dog.

Tests on the second day were staged in open area which was familiar to the dog (e.g. in a park where the dog usually walked with its owner). Familiar location ensured that dogs would behave in a less controlled manner in the following tests: (5) *Threatening approach*, (6) *Playful interaction*, (7) *Food inhibition test* and (8) *Manipulation of the dog's body* (Table 1).

2.3. Procedure

2.3.1. Three-way strange situation test (3-way SST)

The test took place in the experimental room described above. Three chairs were in the middle of the room, each facing one of the doors and were separated from each other by an opaque panel with a height of 1 m. Three balls and three tug toys were also placed on the floor of the room.

The test consisted of 6 short episodes. At the beginning all participants (owner, familiar person, and unfamiliar person) entered the room through the same door. The owner was asked to cover the dog's eyes while entering the room with all the test partners at the same time through the same door chosen randomly for all dogs.

Table 1
 Overview of the testing scheme including the testing location and human partners.

	First day – session 1				Second day – session 2 (1–6 weeks later)			
Name and order of the tests	Three-way strange situation (1)	Call in from food (2)	Obedience test (3)	Walking away (4)	Threatening approach (5)	Playful inter-action (6)	Food inhibition (7)	Manipulation of the dog's body (8)
Testing location	3 m × 5 m experimental room unknown to the dog		Open field unknown to the dog		Open field familiar to the dog (e.g. the park where it usually walks with its owner)			
Human partners	Owner, familiar person, unfamiliar person, female stranger	Owner, familiar person, unfamiliar person						

The three doors of the room allowed the human partners to leave (at the end of the first episode) into three different directions at the same time and, similarly, to enter the room (at the beginning of the fifth episode) from three different directions. The human participants (owner, familiar person, and unfamiliar person) entered and left always through the same door designated for them. The use of different doors was randomised among the subjects tested. The female stranger had never met the dog before the third episode of the three-way strange situation test (see below), and contrary to the unfamiliar person, dogs did not have any possibility to familiarise with the unfamiliar person before the test. The three-way strange situation test is a variation of the Strange Situation Test (see also e.g. Gácsi et al., 2001).

The reason for using simultaneous choice method was that the subsequent choices would have made the experiment very complicated logistically and the comparability could have been also compromised (Fig. 1).

Episode 1 (owner, familiar person, unfamiliar person and dog; 2 min)

All human partners entered the room together with the dog and sat down at their designated place without saying a word. If the dog initiated play with one of them or begged for stroking they were allowed to play with the dog or stroke it, but had to remain seated. At the end of the episode they left the room simultaneously, each person through her door.

Episode 2 (dog alone; 2 min)

The dog was left alone in the room.

Episode 3 (strange woman and dog; 2 min)

The female stranger, who had never encountered the dog, entered the room. She used a different door to enter the room from that the dog and the three test partners used at the beginning of the test. She closed the door and stood next to it for 10 s. If the dog approached her within 1 m she tried to pet it. If the dog stayed further away she started to call it for 5 s. If the dog approached her within 1 m she petted it and then sat in the chair facing the door. If the dog initiated play she was allowed to play with the dog or stroke it if the dog was within 1 m, but had to remain seated. At the end of the episode the stranger left through a door that is different from that she or the dog had used for entering (e.g. if the dog entered the room through door 1 at the beginning of the test then stranger entered the room through door 2 and left the room through door 3, see Fig. 1).

Episode 4 (dog alone; 1 min)

The dog was left alone in the room.

Episode 5 (owner, familiar person, unfamiliar person and the dog; 2 min)

The human partners entered the room simultaneously upon hearing the experimenter's signal. Each of them used the same designated door through she left the room at the end of episode 1. After entering, everyone stopped and stood next to the door for a maximum of 10 s in order to allow the dog to approach someone. If the

dog made a choice (approached any person within 1 m) then they went to their designated chair simultaneously. If any of the human participants was able to stroke the dog, then everyone had to sit down on her designated place. If the dog did not approach anyone within the time limit, the human participants started to call it in simultaneously upon the signal of the experimenter.

If the dog initiated play with one of human partners then she was allowed to play with the dog or pet it if the dog was within 50 cm. At the end of the episode the human participants left the room simultaneously through their designated door.

Episode 6 (dog alone; 1 min)

The dog was left alone in the room.

Observed behavioural variables: In the series of these episodes the duration of the following behaviours were measured:

(1) *'Time spent in contact with any person'*: time in seconds when anybody of the persons touched the dog or vice versa.

(2) *'Time spent playing with any person'*: time in seconds that the dog spent playing with any of the people; this means only playing with the toys that were placed in the room before the test.

(3) *'Time spent standing by any of the doors'*: time in seconds that the dog spent in the 1 m or closer to any door of the room. The calculation was done separately for each person and door, respectively.

The former two behaviours occurred in Episodes 1 and 5. The average duration of these variables were used for further analysis. 'Time spent with standing by the door' was observed in Episodes 2, 4, 6 (when dog was alone) and in Episode 3 (when the stranger was in the room). The duration of values obtained in these four episodes were averaged for further calculations.

2.3.2. Calling in from food

The test took place in the same experimental room described above. The experimenter placed a piece of food in a small cage of 35 cm × 45 cm × 50 cm in the presence of the dog and the human participants. The dog could see the food, had access to the cage but could not get the food (Fig. 2). Three human participants sat next to each other at the opposite end of the experimental room at a distance of 4 m. Their places were randomised among dogs. The experimenter remained in the room to be able to control the human participants' behaviour in order to ensure consistency among test trials. This test consisted of two episodes.

Episode 1

The experimenter gave a piece of food to the dog and put the rest into the cage while the dog was watching it closely. Then she went to the end of the room and turned her back towards the dog and the human participants. The dog was allowed to move freely in the room, its behaviour was observed for 1 min from the time point when the experimenter turned back.

Episode 2

The experimenter gave another piece of food to the dog in order to attract its attention to the cage again. When the dog was oriented at the cage (and therefore at the food) the experimenter asked the

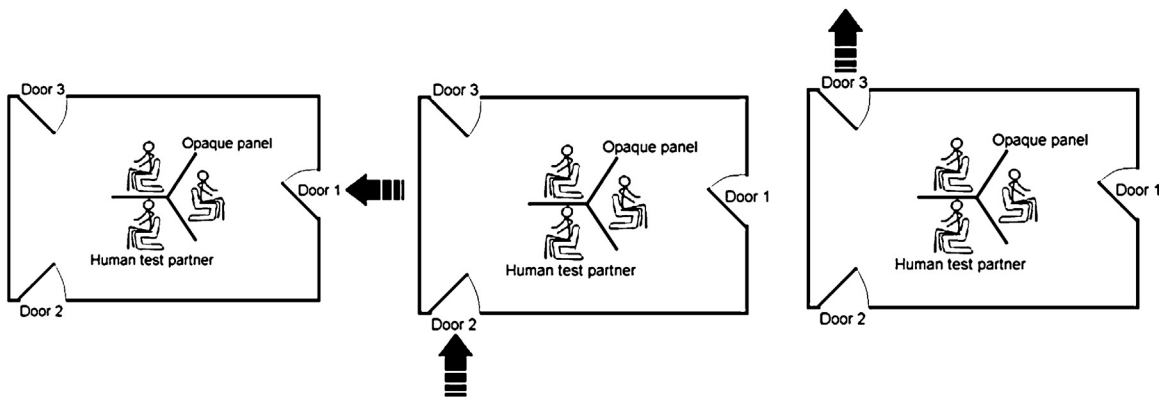


Fig. 1. A possible order of using the doors: If the dog entered the room through Door 1 (see arrow) at the beginning of the test (a) then the stranger entered the room in Episode 3 through Door 2 (b) and left the room through Door 3 (c) (sketch, not to scale).

human partners to call in the dog simultaneously and continuously for 30 s.

Observed behaviour variables: The amount of time the dog spent orienting at the food and at any of the human participants. We measured also the frequency of gaze alternations (looking back and forth between the food and any of the participants) in each episode for each human partner separately (Fig. 2).

2.3.3. Obedience test

The test was carried out in an open field unknown to the dog. The human participants stood in a semicircle, at approx. 2 m distance from each other. The dog was allowed to move freely during the test. The owner, the familiar and the unfamiliar persons were told to (1) call in the dog, (2) make it sit and (3) make it lie down and stay in this position for 15 s. Only gestural signals and verbal commands were allowed, food reward and touching the dog were prohibited. Each human participant had 1 min to complete the task. The three participants could observe each other during the tests. The order of commanding the dog was randomised among dogs, and a short break was inserted between two subsequent trials.

Observed behaviour variables: We noted whether the human partner was able to make the dog complete the task (yes/no) within the time limit, and recorded the latency(s), comparing results within the dog.

2.3.4. Walking away

The test was carried out in an open field unknown to the dog. The dog was taken on leash by the experimenter. The three human participants started to walk away from the dog (Fig. 4), without looking back or paying attention to the dog. On the signal from the

experimenter they separated (at approx. 5 m), and started to walk into three different directions. Five seconds after the separation, the dog was unleashed and it could follow whoever it chose to. The humans walked continuously on their way for 30 s without talking to or looking at the dog. They stopped at the signal given by the experimenter, turned around and started to call in the dog continuously for 30 s. Dogs could run from one person to other. The trial was repeated 3 times changing the direction of the routes walked by the human participants.

Observed behaviour variables: We noted whom the dog followed after having been unleashed. The behaviour of the dog was scored. If the dog followed a person in a trial then this person got one score. This way the score of a person could vary between 0 (never followed by the dog) and 3 (followed in all three trials). The average score of human participants was compared. We recorded the latency of getting within 1.5 m to any of the human partners after the start of the simultaneous calling (Fig. 3).

2.3.5. Threatening approach

This test is a slightly modified version of the threatening test designed by Vas et al. (2005). The test was carried out in an open field well-known to the dog. Three human participants stood next to each other in a semicircle 3 m from each other and the dog. They were not allowed to talk or leave their positions. The dog was held by its collar by a second experimenter, and was positioned to face an approaching experimenter who was wearing a black raincoat with hood on her head. She stood 5 m from the dog, and approached it by moving slowly and haltingly and she looked steadily at the eyes of the dog without any verbal communication. Three seconds after starting the approach the second experimenter released the collar and let the dog go. The woman kept on approaching until she

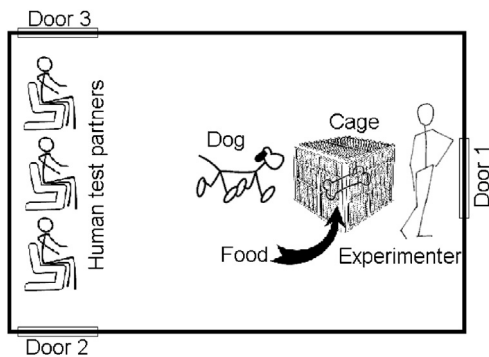


Fig. 2. The setting of the experimental room in the ‘Call in from food’ test. A piece of food was placed in a small cage of 35 cm × 45 cm × 50 cm at one end of the room. Three human participants sat next to each other at the opposite end of the experimental room at a distance of 4 m from the cage.

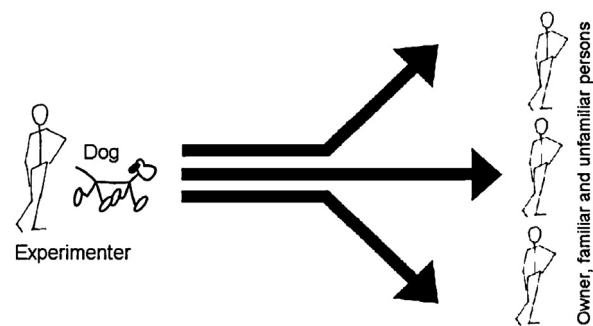


Fig. 3. Illustration for the ‘Walking away’ test. Participants walked away from the dog on signal of the experimenter as indicated by the three different lines. The test was repeated 3 times by switching the participants among the routes. This way each participant walked on each route once.

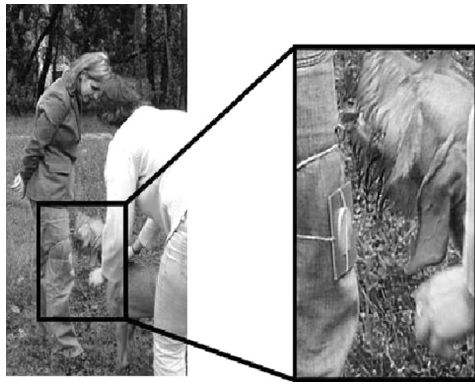


Fig. 4. Fixing the green plate with the food on the human partner's leg in the 'Food inhibition' test.

could reach and pet the dog, or the dog left for one of the human participants within 1.5 m or ran away from the site.

Observed behaviour variable: We noted which human partner (if any) the dog approached after being unleashed.

2.3.6. Playful interaction

Each human participant stood about 2 m next to each other. They were facing the dog that stood 5 m from them. The experimenter held the dog by its collar. Each human participant held a ball with a string in the hand. When the experimenter gave a signal and let the dog go, each human partner tried to engage the dog playing with her instead of the two other humans. They were not allowed to touch the dog or to throw the ball but they could talk to the dog. The test lasted for 1 min. After this, the experimenter played with the dog for 10 s, while the human participants were standing at 2 m from each other in a row. At the end the experimenter threw the ball at least 5 m away. In the moment the dog picked up the ball, each human participant started to call in the dog (the experimenter provided the starting signal) in order to engage the dog for retrieving the ball to her and not to someone else. This part of the test (experimenter playing, throwing away and calling in) was repeated twice.

Observed behaviour variables: We recorded separately for each human partner the duration of orienting at the person or the ball in the person's hand. We noted to whom the dog retrieved the ball. Each time the dog retrieved the ball to one of the human participants she got one score. Thus the score of a human participant varied between 0 (never received the ball) and 2 (the dog took the ball to that person in both cases).

2.3.7. Food inhibition test

The human participants stood in a semicircle 3 m from each other and the dog. A slice of sausage fixed on green plate was tied to each person's leg at the height of the dog's nose (Fig. 5). Test partners were asked not to move their legs and thus the food (e.g. pull it away while the dog smelling or trying to eat it). Dogs were led to everyone one after another (order of test partners were randomised among dogs) and the human participants were asked to prohibit verbally the dog from taking the food away ("No!") only once when it was smelling the food fixed to her leg. Then the dog was led back to the starting position to a distance approx. 3 m and faced the three human partners. After a few seconds the dog was unleashed and was allowed to move freely for 1 min. During this time the dog was not prevented from taking the food if it tried to get it.

Observed behaviour variables: The order of people from whom the dog took the food and the latency(s) of getting the food were recorded. If the dog did not take the food away, maximum latency (60 s, duration of the test) was recorded (Fig. 4).

2.3.8. Manipulation of the dog's body

All three human participants were asked to make the dog sit, lie down, and stay in this position for 15 s. Then they had to turn the dog on its back and had to maintain this position for further 15 s. However, in this case, contrary to the obedience test (see above), the human partners were not allowed to use any verbal commands or gestural signals. Instead, they were asked to push gently the dog's body in order to achieve the required position. In order to investigate whether the dog's behaviour towards each person was consistent, each human partner repeated the task three times, one after another in a randomised order (to exclude effect of order) with 1 min break between subsequent trials.

Observed behaviour variables: We noted whether the human partners were able to complete the tasks within the given time limit (yes/no, and how many times). Each time a person was able to make the dog sit, she got 1 point. Thus the score of a person could vary between 0 (was not able to make the dog sit in any of the three trials) and 3 (made the dog sit in all three trials). Similar scoring system was applied in case of making the dog lie or turn on its back. The average score of human participants was compared. The latency(s) of the completion was also recorded separately for each person, each task (sit, lie, and turn on its back) and each repetition. In the analysis we compared performances of the owner, the familiar and the unfamiliar persons separately in the three trials and among the human partner groups for every trial separately.

2.4. Data analysis

All tests were recorded on video. The recordings were coded frame by frame with ThemeCoder (Magnusson, 1996). Behavioural variables were checked for normal distribution. Dogs' behaviour towards the owner, the familiar person and the unfamiliar woman were compared with repeated measures ANOVA with SNK post hoc test ($p < 0.05$), or in test 8, where data did not pass the test for normality, Friedman ANOVA was used with Dunn post hoc test ($p < 0.05$). Results of post hoc test are mentioned only when either ANOVA or Friedman ANOVA results were significant. There was no difference between female and male dog data, so they were pooled and analysed together.

3. Results

3.1. Three-way strange situation test

There was a significant variation in the time dogs spent in physical contact with (mainly being petted by) the participants ($F_{2,19} = 16.56, p < 0.001$). Post hoc analysis showed that dogs spent more time in physical contact with the owner than with the unfamiliar woman. However, no such difference was found between the familiar woman and the unfamiliar woman. Dogs played slightly more with the owner than with the familiar person, and far more than with the unfamiliar woman ($F_{2,19} = 6.22, p = 0.045$). When the dog was left alone it stood longer at the door through which the owner left the room compared to any other doors ($F_{2,19} = 23.67, p < 0.001$, Fig. 5).

3.2. Call in from food

When people were not allowed to talk to the dog (Episode 1), dogs oriented longer towards the owner than towards the unfamiliar person ($F_{2,19} = 14.83, p < 0.001$). The time spent orienting at the familiar woman did not differ from the time the dog oriented to any of the other test partners.

When people called in the dogs (Episode 2), dogs oriented longer at the owner than at the other two humans ($F_{2,19} = 13.94, p < 0.001$).

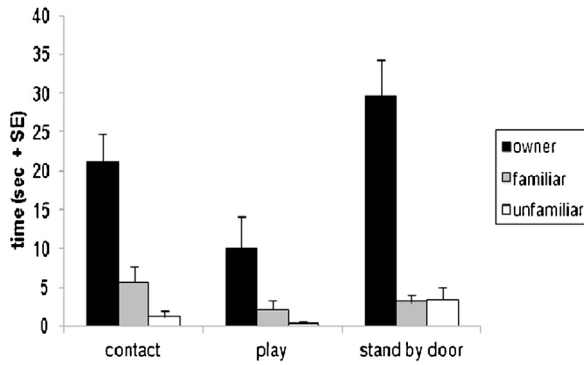


Fig. 5. Time spent in contact, play and stand by door with the owner the familiar and the unfamiliar person.

However, the duration of orienting at the familiar and the unfamiliar person was similar (Fig. 6).

The number of gaze alternations from the food to any of the test partners was different between the owner and the unfamiliar person in both the episodes; dogs looked more often at the owner than to the unfamiliar test partner ($F_{2,19} = 12.04, p < 0.001$ and $F_{2,19} = 7.13, p < 0.001$, respectively) but the frequency of gaze alternations from food to the familiar person was similar to the number of gaze alternations to either the owner or the unfamiliar person.

3.3. Obedience test

In general, owners were more successful in calling in the dog, commanding the dog to sit and lie down than either familiar or unfamiliar persons. For all actions dogs' the familiarity of the human partner had significant effect on the speed of task completion (call in: $F_{2,19} = 5.78, p < 0.001$; sit: $F_{2,19} = 5.93, p < 0.001$; lie down: $F_{2,19} = 3.65, p < 0.05$). Post hoc analyses showed that there was no difference between the effectiveness of the owner and the familiar person, but dogs fulfilled the task significantly slower on the commands of the unfamiliar person.

3.4. Walking away

Dogs followed the owner more frequently than either the familiar or the unfamiliar person ($F_{2,19} = 35.41, p < 0.001$). Post hoc test showed that the frequency of following the familiar and the unfamiliar persons did not differ. After calling in dogs preferred to approach the owner ($F_{2,19} = 47.50, p < 0.001$). The latency of dog's reaching the familiar and the unfamiliar person did not differ significantly.

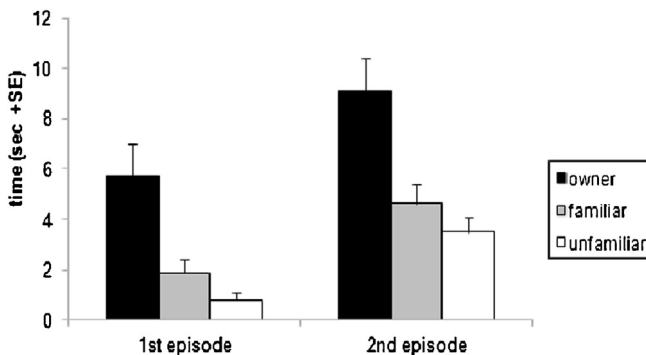


Fig. 6. Time spent with orienting to test partners in the 'Call in from food' test.

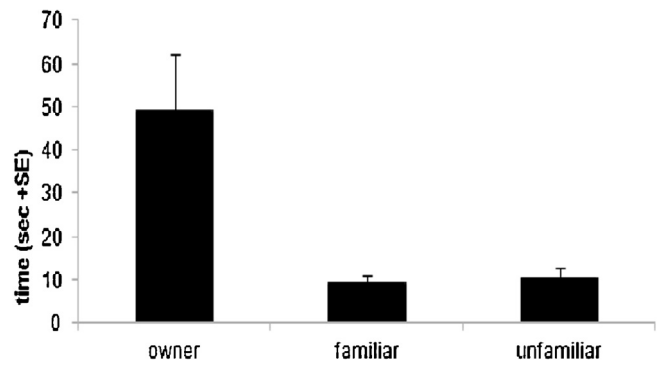


Fig. 7. Time spent with orienting to either the test partner or to the ball in the partner's hand in the 'Play' test.

3.5. Threatening

Seventeen out of twenty dogs ran to the owner (binomial test, probability 0.33: $p < 0.001$), two dogs ran away from the test site and one dog ran to the familiar woman. In this case the familiar woman was the one standing furthest from the approaching experimenter. The experimenter was not able to get close to or pet any of the dogs.

3.6. Playful interaction

There was a significant variation in orienting time towards the different partners ($F_{2,19} = 8.66, p < 0.001$). Dogs oriented for most of the time at the owner and the ball which was in the owner's hand. Post hoc test showed that the time spent orienting to the familiar and the unfamiliar person did not differ significantly (Fig. 7). The owner got a higher score than either the familiar or the unfamiliar woman ($F_{2,19} = 19.18, p < 0.001$).

3.7. Food inhibition

Twelve out of twenty dogs did not take the food from anyone. Two dogs took the food from the owner, two dogs took it only from the familiar person, one from the owner and the unfamiliar person, one from the owner and the familiar person and one from the familiar and the unfamiliar person. The latency of taking the first piece of food away was calculated. There was no significant difference among test partners in the latency of taking the food away ($F_{2,19} = 0.94, p = 0.40$).

3.8. Manipulation of the body

The owner was more successful in making the dog lie down and turn on its back than the other persons (lie down: $F_{2,19} = 7.19, p < 0.05$; turn on back: $F_{2,19} = 11.74, p < 0.001$). No difference was observed in the case of sitting ($F_{2,19} = 2.60, p = 0.27$). There was no difference in the success the familiar and the unfamiliar persons.

In making the dog sit we found no difference in the latency of completing the task across the three trials for any human participants (owner: $F_{2,19} = 1.60, p = 0.45$; familiar: $F_{2,19} = 0.74, p = 0.69$; unfamiliar: $F_{2,19} = 0.70, p = 0.70$). The comparison among the different human participants revealed that owners made the dogs sit quicker than unfamiliar persons in Trial 2, and owners completed the task faster than both of other groups in Trial 3 (Trial 1: $F_{2,19} = 5.09, p = 0.08$; Trial 2: $F_{2,19} = 7.77, p < 0.05$; Trial 3: $F_{2,19} = 11.20, p < 0.05$).

In making the dog lie down, we found no difference in the latencies across the three trials with the owners and familiar persons (owner: $F_{2,19} = 0.63, p = 0.73$; familiar: $F_{2,19} = 5.06, p = 0.08$). The latencies in the three trials of unfamiliar group

differed significantly but the post hoc test showed no difference (unfamiliar: $F_{(2,19)} = 6.68, p < 0.05$). The comparison of the human participants showed significant difference in second trial (Trial 1: $F_{(2,19)} = 1.38, p = 0.50$; Trial 2: $F_{(2,19)} = 6.00, p = 0.05$; Trial 3: $F_{(2,19)} = 1.90, p = 0.39$).

In making the dog turn on its back, we found no difference in the latencies across the three trials with the owners and familiar persons. The latencies in the trials with unfamiliar people differed significantly: on the third attempt the task was completed quicker than on the first attempt (owner: $F_{(2,19)} = 4.31, p = 0.12$; familiar: $F_{(2,19)} = 1.13, p = 0.57$; unfamiliar: $F_{(2,19)} = 10.87, p < 0.01$). The comparison across human participants revealed differences in first and second trials but the post hoc tests were not significant (Trial 1: $F_{(2,19)} = 6.44, p < 0.05$; Trial 2: $F_{(2,19)} = 6.24, p < 0.05$; Trial 3: $F_{(2,19)} = 1.66, p = 0.44$).

The results of all tests are summarised in Table 2.

4. Discussion

We have showed that dogs discriminate less between the owner and a familiar person in situations requiring obedience than in playful, fearful or other intimate situations. In those tests that investigated dogs' social relationship, attachment and playing behaviour towards people (Tests 1, 4, 5 and 6, see in Section 2), dogs clearly distinguished between the owner and any other test participants. Dogs reacted more similarly to the owner and the familiar person in behaviour tests which involved obedience and behaviour towards an assertive person (Tests 2, 3, 7 and 8). The difference between the owner and the unfamiliar person was also obvious in all tests (see also Table 2).

Dogs preferred their owner to any of the other test participants during a playful interaction (Test 6) (orientation time was the longest towards the owner and they took the ball mostly to the owner), and they followed the owner more frequently in Test 4. If they were prevented from following the owner (e.g. in Test 1, Three-way strange situation test) then the dogs stood by the door, where the owner left the room. Owners were more successful in calling in the dog, commanding the dog to sit or lie down (Test 3), or to make it turn on the back (Test 8) in comparison to either the familiar or the unfamiliar person.

Dogs' behaviour towards the familiar person was more context-specific. In some tests the interaction with the familiar person could not be distinguished statistically from that with the owner. The number of gaze alternations 'call in from food' test (Test 2) was similar for the owner and the familiar person in Episode 1. The latency for 'sit' and 'lie down' (in Test 8) and the latency for 'call in' and 'lie down' (in Test 3) were similar in the case of the familiar person and the owner.

Dogs did not seem to discriminate between human partners in the food inhibition test (Test 7). Most dogs did not take the food away if it was prohibited, but they eat all the food at the end of the test, when it was allowed, no matter who gave it.

In general, very little is known about how dogs vary in the nature of their social interactions towards familiar or unfamiliar people in comparison to their owner. The case of family dogs is peculiar because apart from living in a closed group (human family) they encounter regularly both unfamiliar humans and humans whom they had met earlier. According to Westgarth et al. (2008) pet dogs living in the city encounter on average 3–5 persons during the week. A relative large proportion of these people are unfamiliar to these dogs, nevertheless they show a friendly behaviour towards them. Thus dogs may have learnt that these friendly strangers pose no threat to them, especially if the owner is present. Such socialisation by the general public may also explain why dogs interact comfortably with experimenters at the first encounter in

a laboratory setting in the presence of the owner. Thus familiar persons may represent a "fuzzy" group of people in the dogs' life. We should also note, however, that our sample consisted of well-socialised dogs with some training experience, which may not be representative of the pet dog population as a whole.

In our test series dogs showed also a clear preference for the owner if they had to make a choice simultaneously. For example, most dogs followed the owner in the walking away test, and approached the owner when threatened by a stranger. Dogs waited also more in front of the door where their owner left the room. Such behaviours can be interpreted as a manifestation of the 'secure base effect' (e.g. Rajecki et al., 1978; Palmer and Custance, 2008). The execution of the strange situation test (SST) with dogs is often complicated for logistic and practical reasons, thus we suggest that such simple tests may be used as alternatives. Gácsi et al. (2001) showed that 30 min long interaction with a shelter dog is enough to provoke the emergence of social attraction. Tested in the SST, these shelter dogs showed some specific aspects of attachment behaviour towards the stranger. In well socialised family dogs the urge for forming new human social contact is weaker, but nevertheless previous positive experience with other people may facilitate social engagement with unfamiliar people. This may also explain why there was relatively small difference in the dogs' behaviour towards the familiar and the unfamiliar person. This finding in dogs is in contrast to member of some other species. For example, even family cats living with humans do not accept strangers so readily. Miklósi et al. (2005) reported that only 2/3 of family cats could be included a testing series involving a stranger (the experimenter) while 9 out of 10 family dogs participated readily.

With regard to other forms of social interaction, like play, the context may be the most important determinant. Well socialised dogs may show a strong tendency to play with other humans indiscriminately. Several studies have reported such observations in which the motivation for play overcame the owner preference. This is especially the case when the owner was present at a distance (e.g. Rooney and Bradshaw, 2002) but the absence of the owner may reduce play behaviour markedly (e.g. Topál et al., 1998).

Familiarity has only a modest effect on the obedient behaviour of our dogs. Although obedience training may strengthen owner–dog relationship (Voith et al., 1992; Clark and Bover, 1993), very often multiple people are involved in this process, so dogs may generalise their readiness to act in line with human instruction indiscriminately (independently from the commander). However, there is also a large variation in the dogs' responses to trained commands. Braem and Mills (2010) reported that only 68% of dogs responded promptly to their owners' commands at a dog training school, and in other cases ordinary trained dogs may be more responsive to experienced trainers who utilise better communication skills as their owner. In the present study obedience was also context-dependent: with a few exemptions all dogs went to the unfamiliar person when called but only about a third of them accepted the 'lie down' command for the unfamiliar person. Whether this decrease of responsiveness is of social nature or it is the result of some failure to perceive the command (e.g. different body language in comparison to the owner) (see Fukuzawa et al., 2005) has to be investigated in further studies.

It is interesting to compare the dogs' behaviour in the obedience tasks (Test 3) with those in the 'Manipulation of the body' tests (Test 8). In principle, they had to execute the same actions, but in the latter case the owner had to manipulate the body directly. The overall impression was that the difference between the owner and the familiar person emerged stronger in the case of the latter tasks. Although there is very little research on tactile interaction between dog and humans, these findings could indicate some sensitivity of dogs in this respect (McGreevy et al., 2005).

Table 2
 Summary table of results obtained in the test battery.

Test ID and name	Behavioural variable	Owner (O)	Familiar (F)	Unfamiliar (U)	Differences between O, F and U
Test 1 Three-way SST	Contact (<i>s</i> ± SE)	21.15 ± 3.69	5.71 ± 1.98	1.30 ± 0.66	O > F = U
	Play (<i>s</i> ± SE)	10.07 ± 4.05	2.09 ± 1.26	0.40 ± 0.26	O = F = U
	Stand by door (<i>s</i> ± SE)	29.64 ± 4.69	3.19 ± 0.95	3.47 ± 1.66	O > F = U
Test 2 Call in from food	Orientation in Ep1 (<i>s</i> ± SE)	5.74 ± 1.25	1.86 ± 0.56	0.81 ± 0.30	O > F = U
	Orientation in Ep2 (<i>s</i> ± SE)	9.12 ± 1.26	4.63 ± 0.75	3.51 ± 0.57	O > F = U
	Number of gaze alteration in Ep1 (mean ± SE)	1.75 ± 0.40	0.60 ± 0.26	0.15 ± 0.35	O = F, F = U, O > U
	Number of gaze alteration in Ep2 (mean ± SE)	2.90 ± 0.58	1.8 ± 0.43	1.15 ± 0.22	O > F = U
Test 3 Obedience	Number of dogs completing the task	Call in: 20 Sit: 19 Lie down: 18	Call in: 18 Sit: 12 Lie down: 11	Call in: 14 Sit: 9 Lie down: 7	Call in: O > F > U Sit: O > F > U Lie down: O > F > U
	Latency of completing the task: (<i>s</i> ± SE)	Call in: 3.33 ± 1.02 Sit: 7.67 ± 3.33 Lie down: 11.95 ± 4.79	Call in: 10.97 ± 3.99 Sit: 23.16 ± 6.35 Lie down: 28.83 ± 6.13	Call in: 21.47 ± 5.09 Sit: 27.21 ± 5.83 Lie down: 34.48 ± 5.68	Call in: O = F, F = U, O > U Sit: O > F, F = U, O > U Lie down: O = F = U
	Following (mean number ± SE)	2.60 ± 0.12	0.25 ± 0.10	0.15 ± 0.08	O > F = U
	Latency of calling in (<i>s</i> ± SE)	11.55 ± 2.50	29.05 ± 1.26	3.67 ± 0.82	O > F = U
Test 5 Threatening approach	run to (mean ± SE)	0.85 ± 0.08	0.05 ± 0.05	0.00 ± 0.00	O > F = U
Test 6 Playful interaction	Orientation to person/ball (<i>s</i> ± SE)	49.14 ± 13.20	9.17 ± 1.99	10.13 ± 2.37	O > F = U
	Score (mean ± SE)	1.30 ± 0.20	0.30 ± 0.15	0.05 ± 0.05	O > F = U
Test 7 Food inhibition	Latency (<i>s</i> ± SE)	46.08 ± 6.37	50.78 ± 6.16	57.43 ± 4.50	O = F = U
Test 8 Manipulation of the body	Success score: (median, upper and lower quartile)	Sit: 3 (3, 3) Lie down: 3 (3, 3) Turn on back: 3 (3, 3)	Sit: 3 (3, 3) Lie down: 3 (3, 1.25) Turn on back: 2 (3, 0)	Sit: 3 (3, 3) Lie down: 3 (3, 1) Turn on back: 2 (3, 2)	Sit: O = F = U Lie down: O > F = U Turn on back: O > F = U
	Mean latency of completing the task (<i>s</i> ± SE)	Sit: 4.74 ± 1.30 Lie down: 7.79 ± 3.59 Turn on back: 13.08 ± 3.74	Sit: 12.75 ± 4.21 Lie down: 12.55 ± 4.19 Turn on back: 22.76 ± 4.60	Sit: 14.15 ± 3.15 Lie down: 14.26 ± 4.19 Turn on back: 18.79 ± 4.88	Sit: O = F, F = U, O > U Lie down: O = F, F = U, O > U Turn on back: O > F, F = U, O > U

A > B, person A was more successful/quicker than person B; A > B = C: person A was more successful/quicker than person B or C and no significant difference between person B and C; all differences are based on post hoc tests $p < 0.05$.

However, it is still not clear how the absence of the owner influences the behaviour of a family dog, even if a familiar human is present. In some laboratories dogs are tested in the absence of their owner but in the presence of a familiar person. Although the dogs' behaviour in these situations may depend on multiple factors (e.g. familiarity to the experimenter, the testing context etc.), it seems that there is a need for comparative experiments to reveal whether the disruption of the owner-dog contact affects the outcome of the experiment. Fallani et al. (2007) found that during separation dogs for the blind show higher cardiac activation than dogs trained for other purposes. Thus even training experience does not universally

help the dog to overcome the effects of separation from the owner. Moreover, separation-related behaviour problems occur in a large proportion of the pet dog population (see also Lund and Jørgensen, 1999; Konok et al., 2011; Parthasarathy and Crowell-Davis, 2006), thus the absence of the owners during the testing could jeopardise the validity of the behavioural observations. Horn et al. (2013a) showed that the presence or absence of the owner during their test situation had influenced dogs' motivation and therefore the outcome of the trial.

The present study has also some limitations. We cannot exclude that the familiar and unfamiliar person did not compensate in their

behaviour unconsciously, although the unfamiliar was a trained expert. It is more likely that in our dogs extensive training experience may have masked individual differences with regard to humans. We had a relatively small sample because of logistic reasons, so there is a need for conducting similar observations on large groups of family dogs. This may increase the sensitivity of the study and reveal smaller effects of familiarity. We used a fixed test order which could have affected the results in several ways, including carry-over effects from one test to the other or fatigue at the later stages of the testing. However, fixed test order is generally used in personality testing with relatively good success rate (e.g. Svartberg, 2005), and the small sample and other practical reasons (e.g. difficulty in varying indoor and outdoor testing locations) prevented us from a fully-balanced design. Inter-test effects may still be significant, for example the playing interaction with the stranger may have influenced the dogs' reaction to her behaviour in the subsequent test. Rooney and Bradshaw (2002) reported also that playful interaction (independent from its nature) had a positive effect on obedience attentiveness (better compliance with commands, more gazing at experimenter). Finally, these observations are limited to family dogs and their owners how practice a relatively 'outgoing' life style, as they were interested in participating voluntarily in this study. Dogs with less profound social experience may have been more sensitive in their interactions with different people.

In summary, we have shown that in a short series of behaviour tests dogs display differential behaviour towards the owner, a familiar person and an unfamiliar person, however, this difference is partly context dependent. In situations, which involved separation from the owner, dogs preferred clearly the owner, and in this case they did not differentiate between the familiar and unfamiliar person. This suggests also that dogs may behave more naturally in the presence of their owner, and a familiar person is not in the position to take over the owner's social role. These observations strengthen the notion that dogs form an attachment relationship with their owner (Topál and Gácsi, 2012). On the practical side replacing the owner by a familiar person in laboratory tests may affect the behaviour of the dog.

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Appendix A. Participants' data

[0,1-3]Dog[1,0]Owner's age[1,0]Familiar person's age[1,0] Unfamiliar person's age Breed Age Gender Welsh terrier 2 Female 232328 German shepherd 2 Male 262928 Golden retriever 4 Female 302624 Dutch shepherd 2 Male 473728 Mix breed 2 Male 573328 German shepherd 4 Female 171822 Rhodesian ridgeback 5 Male 251824 Leonberger 3 Male 325828 Jack Russel terrier 2 Male 36 Not known 22 Pinscher 2 Female 292222 Pointer 2 Female 242528 Border collie 5 Female 335828 Puli 2 Female 161928 Poodle 7 Female 395228 Mix breed 2 Male 595228 Mudi 1 Male 282524 Malinois 3 Male 312528 Mix breed 6 Female 343928 Mix breed 2 Male 242322 Pointer 4 Female 305328 [0,1-6] Mean age (years) \pm SD $3.1 \pm 1.632.0 \pm 11.433.4 \pm 14.226.2 \pm 2.6$

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