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# The exceptions that prove the rule? Spontaneous helping behaviour towards humans in some domestic dogs

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ABSTRACT

Domestic dogs (*Canis familiaris*) are skilled at reading and correctly responding to human communicative gestures to locate hidden food. Whether they, like chimpanzees, will understand requests for help in retrieving a fallen object, is not known. The aim of this study was to examine whether dogs show spontaneous helping behaviour towards a human experimenter that tries to obtain an object that is out of reach. The object at stake either "accidentally" fell on the floor, or was thrown on the floor by either a familiar (owner) or unfamiliar human. In order to get a better understanding of individual differences between helping and non-helping dogs, the behaviour of all dogs was observed by means of continuous focal animal sampling and scored by means of an ethogram. Personality traits were measured by letting owners rate their dogs on 50 personality adjectives using a 7-point Likert scale. The results demonstrate that six out of 51 dogs showed helping behaviour and did so more in the accidental (experimental) condition, than when the object was thrown on the floor on purpose (control) condition ($P = 0.001$). Dogs in general wagged their tail more ($P = 0.009$) and looked less often towards the test leader ($P < 0.001$) in the experimental condition compared to the control condition, suggesting that they experienced more arousal whenever humans were in need of help. In addition, a principal component analysis indicated to retain 41 adjectives which revealed five personality factors, in line with previous research, that accounted for 60.7 % of the total variance. However, the six exceptional dogs had no outstanding personality traits and were of different breeds suggesting that this did not explain the differences in helping behaviour. We conclude that dogs appear motivated and willing to help humans, but that the majority does not understand the source of the problem or how to assist. We discuss this result in light of the previously reported social skills of dogs and nonhuman primates.

## 1. Introduction

Being able to offer help is fundamental to cooperation and a key social skill that humans show even towards complete strangers. Research has shown that children as young as 18 months old help unfamiliar human experimenters in achieving their goals in several situations (Warneken and Tomasello, 2006) and even help a nonhuman agent (Kenward and Gredebäck, 2013). Instrumental helping (i.e., the tendency to complete another one's goal) was found to be one of the earliest emerging prosocial behaviours that children are capable of and willing to perform. It has been suggested that by the age of two, all skills necessary to help another individual in overcoming instrumental challenges are present (Dunfield and Kuhlmeier, 2013).

Despite claims that spontaneous helping behaviour is a uniquely human trait (Silk et al., 2005), it is known that nonhuman primates in the wild show helping behaviour in the form of grooming, consolation or even food sharing (Muller and Mitani, 2005), but also assist each other during a collaborative hunt (Boesch and Boesch, 1989; Boesch, 1994). Some researchers assume that this behaviour ultimately can be explained by kin selection (e.g., Clutton-Brock, 2002) or reciprocal altruism (Trivers, 1971). However, multiple studies have shown that nonhuman primates do display helping behaviour towards humans in a non-competitive set-up, which obviously cannot be explained by kin selection (Warneken and Tomasello, 2006; Warneken et al., 2007). For example, it has been observed that chimpanzees spontaneously help an experimenter that accidently drops an object (which is not of interest to the chimpanzee) in an out-of-reach task which was the same task used with infants which we mentioned before (Warneken and Tomasello,

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2006).

Chimpanzees are however not the only species in which helping behaviour towards humans has been observed. Interestingly, dogs are able to help people in various situations. They are used during police acts but can also assist a blind person. This, however, requires a lot of training and may not reflect natural tendencies towards helping behaviour. Helping behaviour in dogs has also been studied in the lab. A recent study showed that dogs do not behave prosocially towards a human and do not cooperate in a bar-pulling paradigm where a dog had to pull a rope together with a human in order for the human to retrieve a reward. Importantly, in this experiment, the humans were not allowed to communicate with the dogs (Quervel-Chaumette et al., 2016). However, a study by Bräuer et al. (2013) where communication was allowed, showed that dogs helped humans in an instrumental helping task where it was required for the dog to push a button for a door to open and to provide the human in need access to a room. In a series of experiments, gazing, talking, commanding, and pointing gestures were used to make the dog push the button. When food was available in the to-be-opened room, the dogs pushed the button in almost all trials. When no food was available, the dogs opened the door in 25%–60% of the trials, depending on the experimental condition. Dogs opened the door most frequently when the pointing gesture was used or when the human communicated naturally to the dogs which entailed no predetermined sequence of actions. After examination of the latter communication, dogs were triggered to open the door after the human reached for the target, moved towards the door, and pointed at the button or at the target. There was no difference in either helping the owner of the dog or a stranger which was conflicting with the results of Kaminski et al. (2011) who found a difference in the behaviour of dogs towards their owners compared to strangers where dogs had to indicate where an object was hidden. They found that dogs informed the human about the location of a hidden object more frequently whenever the dog himself was interested in the object, however, this seemed to differ when the human in need was their owner. On the other hand, this difference was then irrespective of the owner's past interest in one particular object (i.e., when given the choice between two objects), suggesting the dogs had difficulties inferring the human's goal in the situation. These studies investigating helping behaviour in dogs have conflicting results and therefore it is still unknown whether dogs are able and/or willing to help a human in need. Furthermore, in the study of Bräuer et al. (2013) and Quervel-Chaumette et al. (2016) the dogs were trained before the experiments started, in order for the dogs to understand how to open the door and help the human in need. This however does not answer the question of whether dogs would spontaneously help a human in need and how much of the results could be explained by training. Additionally, Quervel-Chaumette et al. (2016) suggested further research was needed where dogs were tested in a more naturalistic setting and where communication was allowed.

The aim of the present study was to examine whether dogs show the same spontaneous helping behaviour in the out-of-reach task as chimpanzees and infants (Warneken and Tomasello, 2006). Our pilot study suggested that in general, dogs do not help an experimenter (stranger) in need. However, the pilot consisted of a low number of dogs (N = 11) who were all very young (< 19 weeks old) and had some methodological constraints. We here build on this pilot study and conducted a new experiment with dogs where we replicate the research from Warneken and Tomasello (2006). The general set-up and procedure of this task is thus taken from Warneken and Tomasello (2006) and is straightforward with two conditions: a human experimenter accidently drops an object and tries to reach for it, but fails to pick it up (experimental) as compared to a human experimenter who throws the object on the floor and does not try to reach for it (control). The question is whether or not dogs spontaneously help the experimenter by moving or picking up the object and bringing it to the experimenter. In an earlier study by Bräuer et al. (2013), dogs were first trained to open the door with the button. The major difference with our present study is that we examined *spontaneous* helping behaviour, as was the case in the earlier paper by Warneken and Tomasello (2006). Would dogs, like the majority of chimpanzees and infants, spontaneously help a human experimenter in the out-of-reach task, without being trained to do so, and without a food reward? Furthermore, if so, is there a difference in personality between the dogs who show helping behaviour and those who do not? No study on helping behaviour and personality in dogs has been conducted so far, however, research on human personality indicates that personality traits may matter as it may be among the factors contributing to individual differences in altruism and could possibly explain why some individuals help and some do not (Oda et al., 2014). While one study found that altruism qualities to be part of the Agreeableness component (McCrae et al., 2005) another study assigned it to the Extraversion component of the Five-Factor model (Goldberg, 1990). Furthermore, it has been shown that extraversion contributed most to the frequency of altruistic behaviour according to Oda et al. (2014). We therefore expect dogs who show helping behaviour compared to those who do not, to differ on the components most similar to Extraversion and Agreeableness in humans.

Fifty-one dogs together with their owners participated in our study where they were subjected to the out-of-reach task at their own homes. Dogs in this study were randomly assigned to either the unfamiliar experimenter or the familiar owner group, which meant that either of the two was the test leader and performed the experiment with the dog. Each dog was then randomly subjected to either the experimental condition followed by the control condition or vice versa thus all dogs participated in both conditions. Next to the out-of-reach task, focal behavioural observations of the dogs were taken during the response time. Further, owners filled out a questionnaire assesing dogs' personality, level of training and demographics. We expected dogs to show more helping behaviour in the experimental condition compared to the control condition.

## 2. Methods

### 2.1. Pilot study

The methods of the main study were based on our pilot study which is described in detail in the supplementing material. In brief, the aim of the pilot study was to examine whether dogs are able to display helping behaviour towards humans. Two tests were performed. The first test was the out-of-reach task (Warneken and Tomasello, 2006). If the dog showed the desired behaviour (picking up the object and bringing it to the experimenter (E1)), this was the end of the session. If the dog did not show the desired behaviour, the second test was performed. During the second test, the procedure of the first test was repeated, with a second human experimenter (E2) demonstrating the desired behaviour. Immediately after this demonstration, the first test was repeated again, to examine whether the dog copied the demonstrated desired behaviour. A total of eleven dogs of various breeds and ages (range = 12–19 weeks old) participated in this pilot study. Our observations indicated that out of the eleven dogs that participated in this study only one showed helping behaviour. Given that the average age of the dogs in this sample was very young, we decided to treat this study as a pilot, and repeat the study in adult dogs. For procedural details and a full description of the results, see the supplementary materials.

### 2.2. The current study

To examine whether dogs are able to display helping behaviour towards humans, the out-of-reach task was adopted and performed (Warneken and Tomasello, 2006; details of the procedure are given below). In order to be able to compare this data with the data of the chimpanzees tested by Warneken and Tomasello (2006), the procedure was kept as similar as possible. In addition, an ethogram was designed and used to encode and analyse the dogs' behaviour. Furthermore, a

**Table 1**
Overview of the sex, group, order (of conditions) distribution, ability to retrieve and breed group (FCI) of the 51 dogs.

| | | |
|---|---|---|
| Gender | *Male* | 33 |
| | *Female* | 18 |
| Group | *Experimenter* | 30 |
| | *Owner* | 21 |
| Order | *Experimental – control* | 23 |
| | *Control – experimental* | 28 |
| Ability to retrieve | *Not able to retrieve* | 17 |
| | *Able to retrieve* | 32 |
| | *Unknown* | 2 |
| Breed Group | *1. Sheepdogs and Cattle dogs (except Swiss Cattle dogs)* | 10 |
| | *2. Pinscher and Schnauzer – Molossoid, Swiss Mountain and Cattle dogs* | 3 |
| | *3. Terriers* | 9 |
| | *4. Dachshunds* | 1 |
| | *5. Spitz and Primitive types* | 2 |
| | *6. Scent hounds and related breeds* | 4 |
| | *7. Pointing dogs* | 1 |
| | *8. Retrievers – Flushing dogs – Water dogs* | 9 |
| | *9. Companion and Toy dogs* | 7 |
| | *Unknown* | 5 |

questionnaire was designed based on previous questionnaires (Vermulst and Gerris, 2005; Ley et al., 2009) to acquire basic information about the dogs (e.g., gender, age, training level, ability to retrieve, etc.) and to establish data about their personality.

### 2.2.1. Subjects

After the exclusion of four dogs, a total of 51 dogs (18 of which were female) of various breeds and ages (range = 1.6–14.3 years old) participated in this study. The dogs were classified in different breed groups according to the Federation Cynologique Internationale (FCI) and their ability to retrieve (as reported by their owner) was noted (see Table 1). A complete overview of the demographic data of the dogs can be found in the supplementary materials (see Table 2). The four excluded dogs were left out of the experiment due to either circumstances at the home of the owners which left them unable to execute the experiment according to protocol (e.g., not enough space to perform the experiment) or due to unwillingness of the dog to participate (e.g., by showing fearful and avoiding behaviour). Dog owners were recruited via the distribution of flyers by the authors via social media and in person at the University of Amsterdam. Participants responded by mail or a phone call after which an appointment was scheduled for the experimenter to conduct the experiment at the house of the owner. All dogs were living with their human owner as pets during testing. Three dogs also functioned as detection dogs for the police, however they also lived and were kept as pet dogs by their trainers. The owners took part in the study voluntarily and signed an informed consent regarding research participation. The owners were present during testing independent of which condition was performed. They received instructions about the design of the test. Depending on the condition, the owners just attended the experiment and assisted with their dog if needed (experimenter condition) or actively participated in it (owner condition).

This research was approved by the Ethics Committee of the University of Amsterdam and complies with the Dutch laws on animal welfare.

### 2.2.2. Location

The experiment was conducted at the owners' homes. This was decided in order to make participation in this experiment more accessible for the owner and also to examine the dog's behaviour in his/her own safe environment. The only requirement for participation was that the owners had to have a table at which the out-of-reach task could take place.

### 2.2.3. Measures

The response time of the trials were timed using a stopwatch and were filmed with a video camera on a tripod. A blue, clearly visible pencil case served as the desired obtainable object.

*2.2.3.1. Questionnaire*. Every owner completed a questionnaire after the experiment. The questionnaire was composed of two parts. The first part consisted of questions concerning demographic data of the dogs (e.g., age, sex etc.) and relevant information such as their ability to retrieve. The second part consisted of questions concerning personality traits of the dogs. To obtain information about the personality of the dogs, we used an adjective-based methodology similar to that used in the formulation of the human personality Big Five model. A comprehensive list with 50 personality traits was created by using the Quick Big Five (QBF) questionnaire (Vermulst and Gerris, 2005) retaining 19 items which were found appropriate to dogs. The questionnaire was then supplemented by adding 18 items from the Monash Canine Personality Questionnaire (MPCQ) from Ley et al. (2009) in addition to 13 items created by the researchers, see the Supplementary Methods for the complete questionnaire with all 50 traits. We were interested to investigate whether we would identify the previously researched five factors to use for further analyses. The owners were asked to rate their dog on these 50 questions using a 7-point Likert scale ranging from 1; 'Not at all present in my dog' to 7; 'Fully present in my dog'.

*2.2.3.2. Behaviour*. Behavioural observations were conducted by three observers and checked by the main researcher. The behaviour collection was done by means of video recordings and analysed by focal animal sampling. The observations included a range of four types of behaviour, *locomotive behaviour* reflecting activity and movement, *object behaviour* reflecting any behaviours involving the desired object, *interaction behaviour* reflecting any behaviour towards the experimenter/owner and *stress/arousal behaviour* reflecting behaviour during stressful, exciting or arousing situations. The full ethogram can be found in the supplementing materials (see Table 3). Helping behaviour was defined as "bringing the object closer towards the experimenter/owner" which could be either by picking up the object and releasing it within or closer to arm's reach of the experimenter/owner or by shoving it towards the experimenter/owner within or closer to arm's reach.

### 2.2.4. Procedure

All dogs were tested in both the experimental and control condition in which the experimenter/owner accidentally dropped the object or intentionally threw the object on the floor. The control condition was added to ensure that the dog's motivation was to actually help the experimenter/owner in achieving his/her goal when his/her intention was made clear and to make sure the dog did not simply respond to the drop of the object. Both the experimental condition and the control condition consisted of 5 trials. Thus, each dog performed 10 trials. The order of the conditions was randomized to control for any effects of order on helping behaviour. Furthermore, the type of test leader was randomized as well as whether dogs were randomly assigned to the unfamiliar group in which the experimenter carried out the task, or to the familiar group in which the owner carried out the task.

Before the start of the tests, the dog had 10–15 min to habituate to the object, which was put on the floor, and to get habituated to the experimenter. After that, the dog was positioned approximately one meter away from the experimenter/owner with his head in the direction of the table. Both the experimenter and the owner took place at the table and the actual out-of-reach task began.

In the experimental condition, the object was accidentally dropped on the floor by the experimenter/owner and he/she excessively reached for it followed by three phases: 1) the experimenter/owner gazed at the object for 10 s, 2) he/she alternated his/her gaze between the object

**Fig. 1.** Example of an experimental trial of the out-of-reach task. The testleader (top right) reaches for the object (left) after it was dropped.

and the dog during the next 10 s, 3) the problem was verbalized by saying "My pen bag" and calling the dog's name for another 10 s (see Fig. 1 and Supplementing video material). Therefore, the dog had 30 s to respond and to show helping behaviour towards the experimenter/owner. This procedure was repeated in 5 trials. In the control trials, the experimenter/owner intentionally threw the object on the floor without reaching for it. He/she then only looked at it with a neutral facial expression for 20 seconds. This procedure was repeated for 5 trials as well. The trial outline and duration was copied from Warneken and Tomasello (2006).

*2.2.5. Measures*

*2.2.5.1. Helping behaviour.* Helping behaviour was coded as '1', and no helping behaviour as '0' for each trial. For further analysis with personality, dogs who showed helping behaviour during at least one trial were categorized as helpers '1' and dogs who did not were categorized as non-helpers '0'.

*2.2.5.2. Questionnaire.* For the analysis of the personality data we performed a Principal Components Analysis (PCA) with a Varimax rotation which is an exploratory statistical method allowing multivariate data to be expressed more simply by identifying underlying dimensions that cause correlations between variables (Tabachnick and Fidell, 2001; Field, 2012). In order to determine how many components to retain, eigenvalues (> 1.0), scree plot were used together with a Parallel Analysis (Horn, 1965; O'Connor, 2000). After the number of components was determined, the PCA was run again with a fixed number of components and Crohnbach's alpha was calculated for each component to assess the internal consistency of the scale and compared against the minimum level of 0.70 accepted for this statistic (Tavakol and Dennick, 2011). Component scores were yielded by the regression method and used for further analyses.

*2.2.5.3. Other behavioural observations.* Inter-observer reliability was assessed between the three different observers. The correlations were acceptable (individual 1 vs. individual 2: Spearman correlation: $r = 0.822$, $p < .001$; individual 2 vs. individual 3: Spearman correlation: $r = 0.791$, $p < .001$; individual 1 vs. individual 3: Spearman correlation: $r = 0.746$, $p < .001$). Furthermore, the intraclass correlation coefficient was calculated and considered to be excellent ($ICC_{average\ measures}$: $r = 0.953$, $p < .001$).

*2.2.6. Statistical analyses*

*2.2.6.1. Helping behaviour.* Data (helping behaviour, coded as '1', or no helping behaviour, coded as '0'), were analysed in a generalized linear mixed model with a Binomial probability distribution. Fixed factors included Experimental Condition (Experimental, Control), Test Leader (Unfamiliar experimenter, Familiar owner), Order (Experimental first, Control first) and Retrieving ability (Able to retrieve, Not able to retrieve).

*2.2.6.2. Other behavioural observations.* Apart from helping behaviour, we analysed the four interaction and stress/arousal behaviours that occurred most frequently, being, in order of frequency, wagging the tail, looking at the test leader, panting and touching the test leader. We computed the relative duration of the behaviour. As this yields continuous variables, this data was analysed in generalized linear mixed models with a Gamma probability distribution (Log Link function, to deal with skewness). Fixed factors included Experimental Condition (Experimental, Control), Group (Unfamiliar experimenter, Familiar owner), and Order (Experimental first, Control first). As an exploratory analysis we also investigated whether in the cases that the dog attended to the test leader, their attention diverted to the test leader more slowly in the experimental condition compared to the control condition and whether gaze latency differed between dogs who showed helping behaviour compared to those who did not. To that extent, we measured the time it took to direct gaze at the test leader as measured from the moment the object hit the floor. Since, this yields a continuous variable, this data was analysed in a generalized linear mixed model with a Gamma probability distribution (Log Link function, to deal with skewness). Fixed factors included Experimental Condition (Experimental, Control), Helping Behaviour (Yes, No), Group (Unfamiliar experimenter, Familiar owner) and Order (Experimental first, Control first).

*2.2.6.3. Helping behaviour and personality.* Dogs who were categorized as helpers were compared with dogs who showed no helping behaviour on the average score of the obtained personality components by conducting multiple Independent *t*-tests, using an adjusted *p*-value (Bonferroni correction).

*2.2.6.4. Other behavioural observations and personality.* Again for exploratory purposes, we conducted Spearmans correlations to investigate whether there were associations between the behavioural observations and the personality component scores.

## 3. Results

### 3.1. Helping behaviour

Fifty-one dogs each participated in 10 trials, making 510 trials. In total, we observed 26 instances of helping behaviours (5.1 %) in six dogs of different breeds.

There were no effects of Group or Order but a main effect of Condition was observed $F(1, 485) = 11.447$, $p = .001$ with helping behaviour being more prevalent in the Experimental Condition, 20 instances, compared to the Control Condition, 6 instances (Fig. 2). When only including the six actual helpers, the difference between the Experimental and Control Condition remained significant $F(1, 58) = 11.500$, $p = .001$. Of these six dogs, four were capable to retrieve in their daily life, according to their owner.

### 3.2. Wagging tail

A generalized linear mixed model with a Gamma probability distribution (Log Link function) showed a main effect of Condition, demonstrating that dogs more often wagged their tail in the Experimental Condition compared to the Control Condition $F(1, 231) = 6.985$, $p = .009$ (Fig. 3).

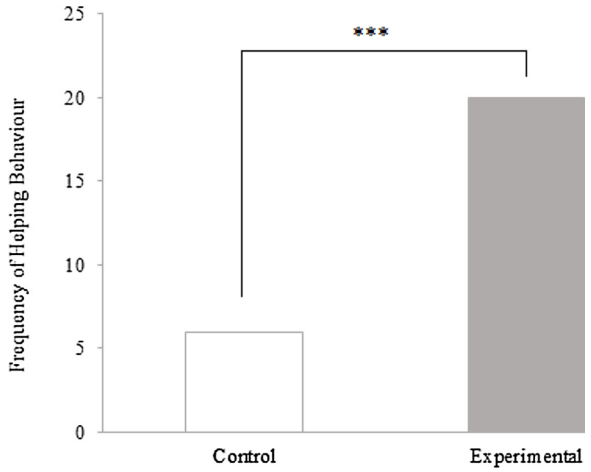


**Fig. 2.** Frequency of helping behaviours for both the control and experimental condition. ***$P < 0.005$.

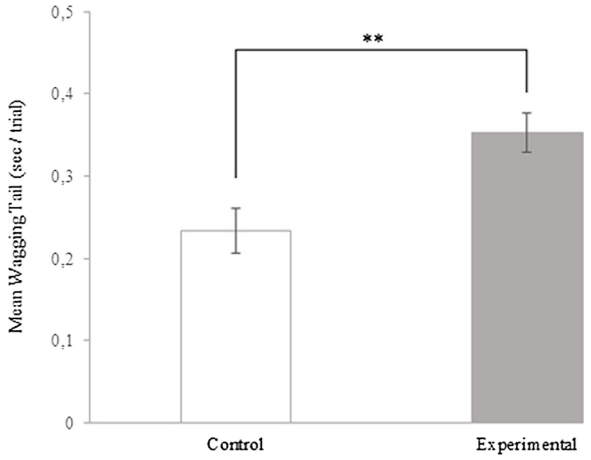


**Fig. 3.** Mean duration of wagging tail for both the control and experimental condition. Error bars represent the SEM. **$P < 0.01$.

### 3.3. Looking at the test leader

A generalized linear mixed model with a Gamma probability distribution (Log Link function) showed a main effect of Group $F(1, 219) = 3.919$, $p = .049$ with dogs looking more at their Familiar owner than at the Unfamiliar test leader. Another main effect of Experimental Condition showed that dogs more often looked at the test leader in the Control Condition compared to the Experimental Condition $F(1, 219) = 30.767$, $p < .001$ (Fig. 4).

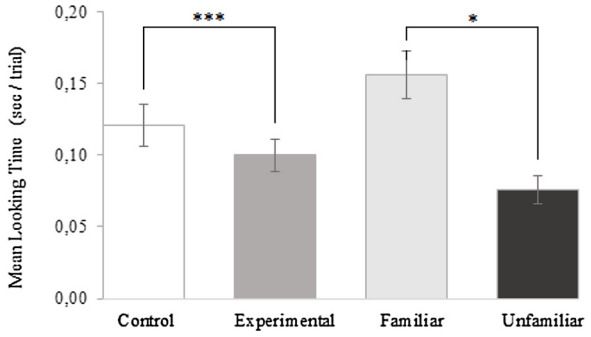


**Fig. 4.** Mean duration of Looking at experimenter for both the control and experimental condition and the familiar (owner) and unfamiliar (experimenter) group. Error bars represent the SEM. ***$P < 0.005$; *$P < 0.05$.

### 3.4. Latency times

In line with the prolonged looking time at the test leader in the Control condition, dogs also directed their gaze more quickly to the test leader (averting their gaze from the object) in the Control condition compared to the Experimental condition $F(1, 268) = 10.911$, $p = 0.001$. No effects of Order, Group or Helping were found.

### 3.5. Panting

There were no main or interaction effects of Group, Condition or Order.

### 3.6. Touching test leader

There were no main or interaction effects of Group, Condition or Order.

### 3.7. Personality analysis

A PCA of the overall data set, followed by Varimax rotation, revealed 13 components with eigenvalues greater than one, which together accounted for 78.6 % of the variance. Examination of the scree plot suggested retaining up to six components (see Fig. 7, supplementary materials) and parallel analysis supported retention of five components. A PCA was run again with five components where six items had a factor loading < 0.4 after which they were removed together with three items from which the reliability analyses showed that the Cronbach's alpha would increase after removal. Thus, a 41 item-solution identified similar to Ley and Bennett (2008) was used to identify five personality components. The five components together accounted for 60.7 % of the variance and all components had an acceptable Cronbach's alpha score, except for component 4 and 5 which were below the accepted cut-off of 0.70 (see Table 4, supplementary materials). We labelled the component respectively Amicability, Neuroticism, Extraversion, Self-assuredness and Training focus.

### 3.8. Helping behaviour and personality

Using independent sample *t*-tests we investigated whether the six helping dogs differed on the five personality components compared to the non-helping dogs. No significant differences were observed ($ps \geq 0.15$, corrected for five tests).

### 3.9. Other behavioural variables and personality

For exploratory purposes, we calculated Spearmans correlations to examine whether the selected behaviours were related to the personality factors. Significant correlations were observed with regards to component 3 Extraversion and 4 Self-assuredness and wagging tail and touching experimenter (Fig. 5). Wagging tail correlated positively with both Extraversion (3) ($r = 0.287$, $p = 0.041$) and Self-assuredness (4) ($r = 0.475$, $p < 0.001$). Touching experimenter correlated positively with Extraversion ($r = 0.321$, $p = 0.022$).

## 4. Discussion

Helping behaviour is of key importance for all social species. In fact, their survival depends on it, as parents from day one on, care for their young. Apart from raising offspring, many species also help conspecifics across different situations and humans and chimpanzees have even been shown to help other species spontaneously (Warneken and Tomasello, 2009). Apart from anecdotal evidence and case reports (e.g., "15 Years Ago Today: Gorilla Rescues Boy Who Fell In Ape Pit," 2011) there is to date no experimental study investigating spontaneous helping behaviour towards another species in other species than

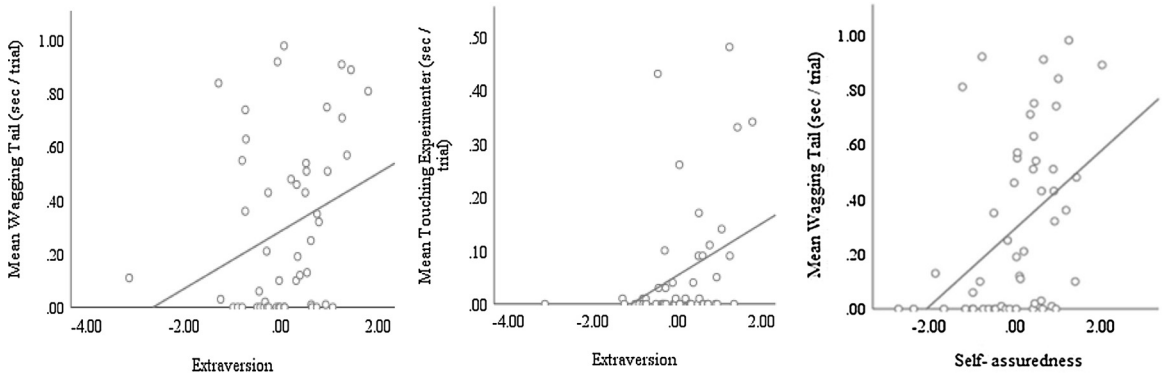


**Fig. 5.** Scatterplots displaying the correlation between wagging tail and Extraversion (r = 0.287), wagging tail and Self-assuredness (r = 0.475) and touching experimenter and Extraversion (r = 0.321).

humans and chimpanzees. The aim of the present study was to fill that knowledge gap and examine whether humans' greatest companions, dogs, are able to show spontaneous helping behaviour towards them. Warneken and Tomasello (2009) argued that to be able to display helping behaviour towards another organism and help them to achieve a goal, one must have an understanding of what that goal is. In addition, to be able to help, one must be motivated to help the other organism in need. The behaviour of the dogs in the present study suggests that dogs are motivated and willing to help a human experimenter in the out-of-reach task, but with six interesting exceptions, the majority did not seem to understand the nature of the goal, or for some other unknown reason, failed to help.

We observed helping behaviour in 26 out of 510 trials. Helping was observed in six out of 51 dogs, which counts as roughly 12 %, similar to the percentage of helping dogs that we observed in our pilot study (one out of eleven). Interestingly, helping behaviour was more frequently observed in the experimental condition compared to the control condition. Dogs that brought the object to the test leader did so regardless of whether it was their owner or a stranger who needed help, which was also found in chimpanzees (Warneken and Tomasello, 2006; Warneken et al., 2007), but not in another study involving dogs (Kaminski et al., 2011). This latter study showed that dogs helped naïve humans to find a hidden object by showing the location of it. However, they were more helpful showing the location of objects they were interested in versus objects they were not interested in. Interestingly, with regards to the objects dogs were not interested in, they helped their owners more often than strangers. It was suggested that the mere presence of the owner could lead to a higher level of arousal and therefore an increase in indicatory behaviours towards the hidden object. In contrast with that suggestion, we did not find a difference in behaviours indicative for arousal such as tail wagging when the owner conducted the task as compared to when the experimenter did so. Thus, at least in the current study the presence of the owner did not seem to increase the dog's level of arousal. Therefore, it is possible that the motivation of dogs to help does not depend upon the familiarity of the recipient as our and other studies indicate (Bräuer et al., 2013; Quervel-Chaumette et al., 2016). Furthermore, helping behaviour in chimpanzees and human children does not depend upon the familiarity of the recipient either (Warneken and Tomasello, 2006; Warneken et al., 2007).

In both the pilot study and the follow-up study, roughly 10 % of the dogs helped, while 90 % of the two samples did not. To understand more about why some individuals did and others did not help, we investigated the personality of the six dogs that showed helping behaviour during the main experiment, which we compared with the majority of the dogs that did not help. To that extent, an exploratory personality analysis was conducted and five factors were extracted, which is in line with previous personality research in dogs (Svartberg and Forkman, 2002; Ley et al., 2007, 2009). Counter-intuitively, no differences in personality traits were observed between dogs that showed helping behaviour compared to those who did not. However, we have to note that the lack of a significant difference may be an issue of insufficient power, explained by the low number of dogs that helped. Furthermore, owners were asked to fill out the questionnaire about their dogs' behaviour and personality in general which can be quite different from the behaviour observed during our experiment. For instance, the owners were explicitly asked about previous indices of helping behaviour. However, it is well possible that these indices did occur, but were not recognized as such, because the "helping" behaviour was misinterpreted as playful or attention-seeking behaviour instead. It is well known that questionnaire data are not the most reliable source of data and usually the questions in the questionnaire concern themselves. Filling out a questionnaire for another individual, i.e., one's dog, might even be more challenging. For that reason, the questionnaire data should be interpreted with some caution.

Next to personality, other factors may be at play. Some dogs may have more experience with retrieving objects than others. Another factor of interest might be the breed of the dogs. Differences in behaviour and sensitivity to human gestures of different breeds have been reported before in the literature (Mehrkam and Wynne, 2014). However, the data of the current study is not in line with these interpretations. The ability to retrieve and breed of the dogs was specified by the owners. We found no evidence that the six successful dogs were more experienced or from any specific breed as four out of the six helping dogs were able to retrieve accounting for 12 % of all dogs able to retrieve in this study. Furthermore, the six helpers were of different breeds; Australian Shepherd, Belgian Shepherd, Labrador, King Charles / Kooiker mix, Podengo and Jack Russel / Staffordshire Bull Terrier mix. These breeds are distributed among four breed groups determined by the FCI. Nevertheless, it would be desirable for future research to have a more equal distribution of dogs from different breed groups as some breeds, such as retrievers, are represented more than others, such as primitive breeds, in this study and previous research (Mehrkam and Wynne, 2014).

The level of intelligence could be an underlying factor accounting for differences in helping behaviour of the dogs where the six helping dogs had a better understanding of the task than all the non-helpers. Research in humans suggests that there indeed might be such a relationship. Specifically, the more intelligent an individual is, the more likely he/she is to act altruistically (Blasi, 1980; Millet and DeWitte, 2007; Proto et al., 2014; Cornwell et al., 2017). This relationship has also been observed in children (Ma and Leung, 1991). Results from Jones (2008) indicate that differences in intelligence could be important drivers of cooperative behaviour where students at different universities cooperate more often in a prisoner's dilemma game whenever their SAT scores increased. Differences in intelligence and consequently performance on cognitive tasks have been observed in

different animal species such as chimpanzees (Vonk and Povinelli, 2011; Herrmann and Call, 2012), kea's and corvids (Auersperg et al., 2011). Whereas some individuals perform exceptionally well on different cognitive tasks, others do not reach that same level of performance. Regarding dogs, interesting case studies with exceptional capacities have been reported. For example, Chaser, a border collie, was capable of comprehending 1022 verbal labels for objects and learn new labels by exclusion (Pilley and Reid, 2011). Chaser was not trained by their owners at first, but was reported to train his owner to play the fetching game (Herrmann and Call, 2012). Few studies on intelligence in nonhuman animals such as dogs have been conducted and contradicting results on the existence of a single general intelligence factor have been reported (Arden and Adams, 2016; MacLean et al., 2017). Nonetheless, there is consensus over the need for more research exploring individual differences and cognitive abilities on multiple tasks (Arden et al., 2016). The level of understanding of the task could nevertheless have played an important role in the current study. Possibly, the six helping dogs were not just more motivated to help, but had a better understanding of how to help. Not knowing how to help may have been an inhibiting factor in the non-helping dogs. Furthermore, research on different coping styles used by avalanche dogs showed that a proactive strategy (i.e., intensive explorative behaviours and few referential gazes towards the handler) increased the likelihood of a successful performance in a search trial (Diverio et al., 2017). Differences in coping styles could have explained the difference between helping and non-helping dogs. This would possibly have been reflected in differences between helping and non-helping dogs in the Extraversion personality component scores as it includes traits such as explorative, investigative, and curious. However, as mentioned before, insuffient power due to the limited number of dogs that helped could have caused the lack of significant differences.

In order to examine behavioural differences between helpful and non-helpful dogs, next to a personality analysis, behavioural observations were made during the experiment. Two main effects were found for looking at the test leader where 1) dogs looked more often towards their test leader in the control compared to the experimental condition and 2) they looked more often towards a familiar test leader (owner) compared to an unfamiliar one (experimenter). This difference in gazing behaviour has been observed in agility dogs (Marshall-Pescini et al., 2009) and pet dogs as well (Mongillo et al., 2017). Similar to our study, these studies also demonstrated that more time was spent looking at their owner compared to a stranger in various cognitive and attention tasks. Differences in looking behaviour towards familiar or unfamiliar test leaders can be deduced from the potential strong relationship between dogs and their owners (Tópal et al., 1998; Gácsi et al., 2001; Prato-Previde et al., 2003; Palmer and Custance, 2008). Eye contact between dogs and their owners facilitates and modulates an interspecies oxytocin-mediated positive loop where oxytocin levels of the owner rise after their dog gazes at him/her, which consequently facilitated the owner's affiliation and oxytocin levels in the dog (Nagasawa et al., 2015). Furthermore, being in an experimental set-up, dogs may be more attentive and focussed on their owners and await cues or commands on what to do in such a situation and engage in information-seeking behaviour (Kaminski et al., 2011; Horn et al., 2013; Udell, 2015). Looking more often towards the test leader in the control condition where the test leader, after the object had been dropped from the table, looked at the object with a neutral face, could be due to the dog not knowing how to respond. No action is required from the dog in such a situation and possibly therefore, they looked more often at the test leader in order to receive cues or commands on what to do. This is also in line with the exploratory analysis on looking latency where dogs in the control condition had a shorter latency compared to dogs in the experimental conditions. Multiple studies have indicated that, when faced with an unsolvable problem, dogs tend to approach humans using their gaze as a communicative signal and humans as tools to solve the problem (Miklósi et al., 2003, 2005; Hare, 2004). Furthermore, dogs respond to different attentional states of humans, where eye contact seems to be pivotal, by adapting their behaviour accordingly (Call et al., 2003; Schwab and Huber, 2006). These results indicate subtle differences in behaviour which can occur when using familiar versus unfamiliar humans in an experimental set-up when dog behaviour is studied. Future research should therefore take note of this.

Another subtle difference in behaviour was observed regarding tail wagging. Dogs more often wagged their tail during the experimental condition compared to the control condition. Wagging their tail can suggest that the dogs were more aroused in the experimental condition (Siniscalchi et al., 2013) where the test leader actively reaches out, expressing himself/herself verbally and alternating gaze between the dog and the object and thus makes use of ostensive cues towards the dog. It has been shown that dogs' activity levels are higher when the human uses vocal and bodily cues to encourage them in the task at hand (Bräuer et al., 2013; Udell, 2015). This shows that dogs respond differently in the experimental compared to the control condition where they wagged their tail more and looked less often towards the test leader, suggesting they were behaving differently and responding to the communicative behaviour shown by the test leader. Bräuer et al. (2013) also found that dogs only helped when the human in need communicated their desire in a naturalistic way. Furthermore, Quervel-Chaumette et al. (2016) did not find dogs to be prosocial towards humans (in contrast to being prosocial towards conspecifics) in a food delivery paradigm, regardless of their familiarity. They suggested that the lack of communication (which was instructed) of the humans towards the dogs may have been aversive to them, leading them to cease performing the task earlier compared to the same set-up with conspecifics. They suggested further studies to examine prosocial behaviour in dogs towards humans taking into consideration their potential responses both with and without human communication.

In the current study, we investigated spontaneous helping behaviour of dogs towards humans in an out-of-reach task, adopted from Warneken and Tomasello (2006), without prior training. The majority of the dogs in our study did not show spontaneous helping behaviour towards humans which is partially in line with the results of Quervel-Chaumette et al. (2016), Kaminski et al. (2011) and Macpherson and Roberts (2006) but in contrast with Bräuer et al. (2013) and unlike the majority of chimpanzees (Warneken and Tomasello, 2006; Warneken et al., 2007). When reviewing dogs' behaviour in the current study and previous research, it strongly suggests that dogs are motivated and willing to help a human experimenter with the out-of-reach task, but that most of them simply do not understand what the goal is, in contrast to the chimpanzees studied by Warneken and Tomasello (2006). That said, it is possible that in that study, the chimpanzees helped because they had received rewards when performing prosocial behaviours towards humans in the past (Warneken et al., 2007). The same could be true for the dogs in our study. We cannot exclude that the dogs were not trained in the past to pick up objects and return them to the owner, nor if this was ever taught in dog training courses. If a dog was rewarded in the past for this helping behaviour than it is likely to help in our experimental setting.

In sum, the current study does not allow us to conclude that dogs are uncapable of showing spontaneous helping behaviour since we have observed six dogs in the main experiment and one in the pilot study that actually did show this behaviour. These dogs brought the object towards the test leader and therefore helped, especially when humans most needed it. As mentioned before, understanding the task and consequently the desire of the human in need might have been lacking in the majority of the dogs, an interpretation supported by previous experimental studies investigating prosocial behaviour in dogs (Bräuer et al., 2013; Quervel-Chaumette et al., 2016). In these studies dogs were trained to understand the task in hand followed by a prosocial choice prior to the experiments. One could argue that the dogs were therefore instrumentally guided towards the goal, rather than determining it

themselves and understanding what the human wanted. For that reason, no training was used in the current study, leading to only six individuals being able or willing to help in the main experiment. Individual differences, breed and rearing history can shape behaviour which should be taken into account in future studies investigating prosocial behaviour in dogs.

Even though the results of the present study suggest that the majority of dogs are not able to show spontaneous helping behaviour towards people, we cannot conclude that they are incapable of this because of the exceptions. Therefore, we encourage future research to continue investigating the (pro)social skills of dogs, taking into account individual differences, breed, methodology and test leader.

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## Animal welfare note

This research has been approved by the LAB Ethics Review Board, The Faculty of Social and Behavioural Sciences, University of Amsterdam (UvA). The research protocol number is 2010-DP-1348.

We have complied with the APA ethical principles regarding research with human participants and/or care and use of animals in the conduct of the research presented in this manuscript.

## Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.applanim.2020.104941.

## References

Arden, R., Adams, M.J., 2016. A general intelligence factor in dogs. Intelligence 55, 79–85.
Arden, R., Bensky, M.K., Adams, M.J., 2016. A review of cognitive abilities in dogs, 1911 through 2016: more individual differences, please!. Curr. Dir. Psychol. Sci. 25, 307–312.
Auersperg, A.M.I., von Bayern, A.M.P., Gajdon, G.K., Huber, L., Kacelnik, A., 2011. Flexibility in problem solving and tool use of kea and new caledonian crows in a multi access Box paradigm. PLoS One 6 (6), e20231.
Blasi, A., 1980. Bridging moral cognition and moral action: a critical review of the literature. Psychol. Bull. 88 (1), 1–45.
Boesch, C., 1994. Cooperative hunting in wild chimpanzees. Anim. Behav. 48, 653–667.
Boesch, C., Boesch, H., 1989. Hunting behavior of wild chimpanzees in the Tai National Park. Am. J. Phys. Anthropol. 78, 547–573.
Bräuer, J., Schöneveld, K., Call, J., 2013. When do dogs help humans? Appl. Anim. Behav. Sci. 148 (1–2), 138–149.
Call, J., Brauer, J., Kaminski, J., Tomasello, M., 2003. Domestic dogs (*Canis familiaris*) are sensitive to the attentional state of humans. J. Comp. Psychol. 117, 257–263.
CBS Chicago, 2011. 15 Years Ago Today: Gorilla Rescues Boy Who Fell In Ape Pit. http://chicago.cbslocal.com/2011/08/16/15-years-ago-today-gorilla-rescues-boy-who-fell-in-apepit/.
Clutton-Brock, T., 2002. Breeding together: kin selection and mutualism in cooperative vertebrates. Science 296 (5565), 69–72.
Cornwell, J.F., M, F., B, H., Tory, E., 2017. How the “truth” self relates to altruism: when your problem is mine. Soc. Cogn. 35, 204–226 Special Issue: The Phenomenal Self.
Diverio, S., Menchetti, L., Riggio, G., Azzari, C., Iaboni, M., Zasso, R., Di Mari, W., Santoro, M.M., 2017. Dogs’ coping styles and dog-handler relationships influence avalanche search team performance. Appl. Anim. Behav. Sci. 191, 67–77.
Dunfield, K.A., Kuhlmeier, V.A., 2013. Classifying prosocial behaviour: children’s responses to instrumental need, emotional distress, and material desire. Child Dev. 84 (5), 1766–1776.
Field, A., 2012. Discovering Statistics. Sage, London.
Gácsi, M., Topál, J., Miklósi, Á., Dóka, A., Csányi, V., 2001. Attachment behaviour of adult dogs (Canis familiaris) living at rescue centers: forming new bonds. J. Comp. Psychol. 115, 423–431.
Goldberg, L.R., 1990. An alternative “description of personality”: the Big-Five factor structure. J. Pers. Soc. Psychol. 59 (6), 1216–1229.
Hare, B., 2004. Domestic dogs use humans as tools. In: Bekoff, M. (Ed.), Encyclopedia of Animal Behaviour. Greenwood, Westport, pp. 277–285.
Herrmann, E., Call, J., 2012. Are there geniuses among the apes? Philos. Trans. R. Soc. Lond., B, Biol. Sci. 367, 2753–2761.
Horn, J.L., 1965. A rationale and test for the number of factors in factor analysis. Psychometrika 30, 179–185.
Horn, L., Range, F., Huber, L., 2013. Dogs’ attention towards humans depends on their relationship, not only on social familiarity. Anim. Cogn. 16, 435–443.
Jones, G., 2008. Are smarter groups more cooperative? Evidence from prisoner’s dilemma experiments, 1959–2003. J. Econ. Behav. Organ. 68, 489–497.
Kaminski, J., Neumann, M., Bräuer, J., Call, J., Tomasello, M., 2011. Dogs, Canis familiaris, communicate with humans to request but not to inform. Anim. Behav. 82, 651–658.
Kenward, B., Gredebäck, G., 2013. Infants help a non-human agent. PLoS One 8 (9), e75130.
Ley, J., Bennett, P., 2008. Measuring personality in dogs. J. Vet. Behav. Clin. Appl. Res. 3, 182.
Ley, J., Bennett, P.C., Coleman, G.J., 2007. Personality dimensions in companion canines. Appl. Anim. Behav. Sci. 110, 305–317.
Ley, J.M., Bennett, P.C., Coleman, G.J., 2009. A refinement and validation of the Monash canine personality questionnaire (MCPQ). Appl. Anim. Behav. Sci. 116, 220–227.
Ma, H.M., Leung, M.C., 1991. Altruistic orientation in children: construction and validation of the child altruism inventory. Int. J. Psychol. 26 (6), 745–759.
MacLean, E.L., Herrmann, E., Suchindran, S., Hare, B., 2017. Individual differences in cooperative communicative skills are more similar between dogs and humans than chimpanzees. Anim. Behav. 126, 41–51.
Macpherson, K., Roberts, W.A., 2006. Do dogs (Canis familiaris) seek help in an emergency? J. Comp. Psychol. 120, 113–119.
Marshall-Pescini, S., Passalacqua, C., Barnard, S., Valsecchi, P., Prato-Previde, E., 2009. Agility and search and rescue training differently affects pet dogs’ behaviour in socio-cognitive task. Behav. Processes 81, 416–422.
McCrae, R.R., Costa Jr., P.T., Martin, T.A., 2005. The NEO–PI–3: a more readable revised NEO personality inventory. J. Pers. Assess. 84 (3), 261–270.
Mehrkam, L.R., Wynne, C.D.L., 2014. Behavioral differences among breeds of domestic dogs (Canislupus familiaris): current status of the science. Appl. Anim. Behav. Sci. 155, 12–27.
Miklósi, A., Kubinyi, E., Topál, J., Gácsi, M., Virányi, Z., Csányi, V., 2003. A simple reason for a big difference: wolves do not look back at humans but dogs do. Curr. Biol. 13, 763–766.
Miklósi, A., Pongrácz, P., Lakatos, G., Topál, J., Csányi, V., 2005. A comparative study of dog– human and cat–human interactions in communicative contexts. J. Comp. Psychol. 119, 179–186.
Millet, K., Dewitte, S., 2007. Altruistic behavior as a costly signal of general intelligence. J. Res. Pers. 41, 316–326.
Mongillo, P., Pitteri, E., Marinelli, L., 2017. Sustained attention to the owner is enhanced in dogs trained for animal assisted interventions. Behav. Processes 140, 69–73.
Muller, M.N., Mitani, J.C., 2005. Conflict and cooperation in wild chimpanzees. In: In: Slater, P.J., 17, B., Rosenblatt, J., Snowdon, C., Roper, T., Naguib, M. (Eds.), Advances in the Study of Behaviour, vol. 35. Elsevier, New York, pp. 275–331.
Nagasawa, M., Mitsui, S., En, S., Ohtani, N., Ohta, M., Sakuma, Y., Onaka, T., Mogi, K., Kikusui, T., 2015. Oxytocin-gaze positive loop and the coevolution of human-dog bonds. Science 348, 333–336.
O’Connor, B.P., 2000. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer’s MAP test. Behav. Res. Methods Instrum. Comput. 32, 396–402.
Oda, R., Machii, W., Takagi, S., Kato, Y., Takeda, M., Kiyonari, T., Fukukawa, Y., Hiraishi, K., 2014. Personality and altruism in daily life. Pers. Individ. Dif. 56, 206–209.
Palmer, R., Custance, D., 2008. A counterbalanced version of Ainsworth’s Strange Situation Procedure reveals secure-base effects in dog–human relationships. Appl. Anim. Behav. Sci. 109, 306–319.
Pilley, J.W., Reid, A.K., 2011. Border collie comprehends object names as verbal referents. Behav. Processes 86, 184–195.
Prato-Previde, E., Custance, D.M., Spiezio, C., Sabatini, F., 2003. Is the dog-human relationship an attachment bond? An observational study using Ainsworth’s strange situation. Behaviour 140, 225–254.
Proto, E., Rustichini, A., Sofianos, A., 2014. Higher intelligence groups have higher cooperation rates in the repeated prisoner’s dilemma. Working Paper. University of Warwick.
Quervel-Chaumette, M., Mainix, G., Range, F., Marshall-Pescini, S., 2016. Dogs do not show Pro- social preferences towards humans. Front. Psychol. 7, 1416.

Schwab, C., Huber, L., 2006. Obey or not obey? Dogs (*Canis familiaris*) behave differently in response to attentional states of their owners. J. Comp. Psychol. 120 (3), 169–175.
Silk, J.B., Brosnan, S.F., Vonk, J., Henrich, J., Povinelli, D.J., Richardson, A.S., Lambeth, S.P., Mascaro, J., Schapiro, S.J., 2005. Chimpanzees are indifferent to the welfare of unrelated group members. Nature 437, 1357–1359.
Siniscalchi, M., Lusito, R., Vallortigara, G., Quaranta, A., 2013. Seeing left- or right-asymmetric tail wagging produces different emotional responses in dogs. Curr. Biol. 23, 2279–2282.
Svartberg, K., Forkman, B., 2002. Personality traits in the domestic dog (Canis familiaris). Appl. Anim. Behav. Sci. 79, 133–157.
Tabachnick, B.G., Fidell, L.S., 2001. Using Multivariate Statistics. Allyn and Bacon, Boston, pp. 582–583.
Tavakol, M., Dennick, R., 2011. Making sense of Cronbach's alpha. Int. J. Med. Educ. 2 (53), 55.
Tópal, J., Miklósi, A., Csányi, V., Dóka, A., 1998. Attachment behaviour in dogs (*Canis familiaris*): a new application of Ainsworth's (1969) strange situation test. J. Comp. Psychol. 112 (3), 219–229.
Trivers, R.L., 1971. The evolution of reciprocal altruism. Q. Rev. Biol. 46 (1), 35–57.
Udell, M.A.R., 2015. When dogs look back: inhibition of independent problem-solving behaviour in domestic dogs (*Canis lupus familiaris*) compared with wolves (*Canis lupus*). Biol. Lett. 11 (9).
Vermulst, A.A., Gerris, J.R.M., 2005. QBF: quick big five persoonlijkheidstest handleiding (Quick big five personality test manual). Leeuwarden: LDC.
Vonk, J., Povinelli, D.J., 2011. Individual differences in long-term cognitive testing in a group of captive chimpanzees. Int. J. Comp. Psychol. 24, 137–167.
Warneken, F., Tomasello, M., 2006. Altruistic helping in human infants and young chimpanzees. Science 311 (5765), 1301–1303.
Warneken, F., Tomasello, M., 2009. The roots of human altruism. Br. J. Psychol. 100 (3), 455–471.
Warneken, F., Hare, B., Melis, A.P., Hanus, D., Tomasello, M., 2007. Spontaneous altruism by chimpanzees and young children. PLoS Biol. 5 (7), e184.