DOG-DIRECTED PARENTING

AND OPTIMISM BIAS IN DOGS

De Waele H.

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Abstract

Parenting styles have been shown to influence the affect and well-being of children and interestingly the parenting relationship exists also between owner and dog, which raises the question if dog-directed parenting styles also have consequences for the welfare of dogs. This paper reviews the association between parenting styles and optimism bias in dogs and describes research that, firstly, aimed to improve the existing cognitive bias protocols and investigate the value of the cognitive bias test in assessing a dogs' optimism bias. Secondly, the relationship between a dogs' optimism bias and the owners' parenting style was examined.

An online questionnaire was employed to categorize the parenting style of 223 dog owners and 34 owners were thereafter invited to participate in behavioural tests. Two different versions of the cognitive bias test were developed and the benefits and limitations of the different versions were investigated in comparison to previously developed protocols. In total, nine different cognitive bias protocols were analysed, and linear mixed model analyses of 4,220 records on 170 dogs revealed that depending on the protocol, dogs generally learn to discriminate between the positive and negative cues over trials. Cognitive bias protocols based on spatial discrimination worked substantially better than tests based on size discrimination. The standard spatial discrimination protocol worked consistently well, even when employed by different experimenters and with slight variations in the protocols. Tests in which responses to negative cues were 'punished' with another negative cue presentation worked equally well as the standard spatial test, but with the added benefit of the dogs discriminating between the two cues in less trials. Cognitive bias tests where dogs successfully discriminated between the positive and negative location (n=19) were identified by ANOVA and then used to calculate optimism scores. No correlations were found between optimism scores and parenting styles of owners, but an inverse relationship was found between parental demandingness and the dogs' optimism score. The more demanding an owner, the less optimistic the dog, indicating undue parental demandingness may impair the welfare of dogs especially in the absence of parental responsiveness. These findings may be useful for identifying good practices in dog-directed parenting, promote these and thus improve owner-dog relationships and subsequently preventing dog abandonment.

Keywords: Dog, *Canis familiaris*, parenting styles, optimism bias, cognitive bias test

1 INTRODUCTION

Dog owners often consider their pet dog part of the family, regarding them as a child or a close companion. Their relationship has similarities to the bond children have with their parents, with owners employing similar parenting strategies. However, if owners are dissatisfied with this relationship, it may lead to the relinquishment of the dog (Salman et al., 2000; Vućinić et al., 2009). A dogs' behaviour and the relationship between owner and dog may be dependent on the owner's parenting style. To further improve owner-dog relationships, and prevent dog abandonment, this research aims to further examine the consequences of these dog-directed parenting styles for dogs.

The strategies and specific patterns of behaviour that parents use to raise their children manifest as parenting styles. Many existing classifications of parenting practices build on Baumrind's classification of these styles, characterized by the two underlying dimensions responsiveness and demandingness. Responsiveness refers to the extent that a parent is sensitive, supportive and provides emotional warmth for the child. It reflects the degree to which a parent responds to their child's needs and wishes. Demandingness refers to the claims and demands parents place on their children. Aspects of parental demandingness include supervision of the child and the practice of confrontive control through disciplinary efforts by directly confronting the child. Demandingness also encompasses the provision of structure, order and predictability for the child. Variation in the 2-dimensional space of responsiveness and demandingness was initially represented by parenting styles authoritative, authoritarian, and permissive or uninvolved parenting (see Figure 1, (Baumrind, 1971). The authoritarian style manifests as being demanding, with low levels of responsiveness. These parents are neither warm nor responsive to their children. The expectations for their children are excessively high, as is the control they exert over them. When the imposed rules or limits are broken, their children face harsh discipline, often through verbal or physical punishment. The permissive style scores low on demandingness, while these parents are thought to be variable in their responsiveness, with some scoring high and some scoring low. They are indifferent in their expectations for their children and they exhibit a high tolerance for misbehaviour, resulting in excessive freedom and low levels of discipline for the child. The permissive style can be further classified into the uninvolved style, which is reflected by low levels of both demandingness and responsiveness (McCoby, 1983). The last class, the authoritative style, involves high levels of demandingness and responsiveness. Baumrind suggested that authoritative parents are warm and receptive, providing their children with affection and support, while also having high expectations for them. The children of authoritative parents are encouraged to attain these expectations through communication, induction and encouragement. This style is marked by patterns of consistency and non-punitive discipline (Karavasilis, Doyle, & Markiewicz, 2003). To identify parenting styles, Robinson et al. developed the Parenting Styles and Dimensions Questionnaire (PSDQ), consisting of 62 questions based on self-reports by parents (C. C. Robinson, Mandleco, Olsen,

& Hart, 1995). Eventually, in 2001, the questionnaire was reduced to 32 items by (C. Robinson, Mandleco, Olsen, & Hart, 2001).

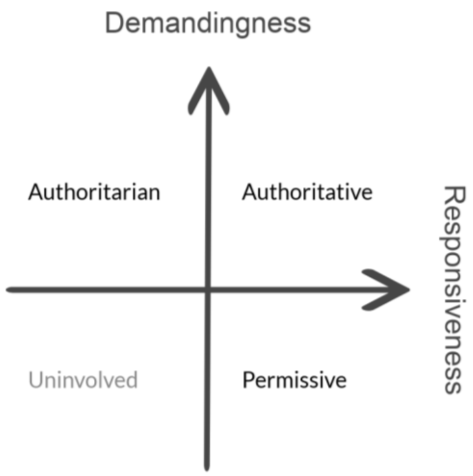

Figure 1. Visual representation of Baumrind's classification of parenting styles using two dimensions: demandingness and responsiveness. the four parenting styles are authoritarian (high demandingness, low responsiveness), authoritative (high demandingness, high responsiveness), uninvolved (low demandingness, low responsiveness) and permissive (low demandingness, low responsiveness).

These parenting styles are relevant since they seem to influence child development and well-being. Various studies have found associations between different parenting styles and adaptations of the child. Most studies consider authoritative parenting the most ideal child-rearing strategy, as this style is associated with the most positive outcomes for the child. An example of this is the association between authoritative parenting and academic competence, as well as self-reliance of the child (Lamborn, Mounts, Steinberg, & Dornbusch, 1991). The outcomes of a questionnaire showed significantly higher levels of school achievements in authoritatively-parented children than in children raised with a different parenting style (Lamborn et al., 1991). Furthermore, when at least one parent acts authoritative this already protects against delinquency and depression in adolescents (Simons & Conger, 2007). Interviews and questionnaires of British 15-year olds revealed that authoritative parenting promoted self-esteem and subjective well-being (Chan & Koo, 2010). Another piece of evidence was provided by 414 children and their mothers through self-reports, where a positive association existed between authoritative parenting and a secure attachment between the child and its mother (Chan & Koo, 2010). A secure attachment style, in return, is associated with less aggressiveness, less disruptiveness, and more maturity. All these examples demonstrate the benefits of utilizing an authoritative parenting style (Spera, 2005).

Considering these parenting styles are so impactful on the well-being of children, the question arises as to whether they can be extrapolated to owner-dog relationships. Various articles provide evidence for similarities between the bond of parent-child and owner-dog. Using a survey on 343 dog adopters, Neidhart & Boyd (2002) found that almost half of these dog owners regarded their dog as a child or close companion, while the other half indicated the dog was considered to be part of the family. In Germany, 93% of 14,004 dog owners also reported that they regard their dog as part of the family (Kubinyi, Turcsán, & Miklósi, 2009). Furthermore, the way owners interact with their dog, such as the way they talk and play with them, can be typed as interspecific parental behaviour (Prato-Previde, Custance, Spiezio, & Sabatini, 2003). Dogs even seem to exploit our tendencies towards empathy by tapping into human-like modes of communication, such as mutual gazing. This gazing associates with increases in oxytocin levels, which supposedly facilitates social attachment (Nagasawa, Kikusui, Onaka, & Ohta, 2009). Because the care provided by owners for their pet mirrors that which parents provide for their child, German (2015) suggested dog-directed parenting styles might exist and this was confirmed by Van Herwijnen et al. (2018). Her research showed that, just like with children, dog owners adopt similar parenting styles to raise their dogs. Principal Component Analyses allowed them to group the questions in three categories or dog-directed parenting styles. They identified an authoritarian-correction oriented style, focussed on verbal or physical correction, and two styles based on authoritative items. The first one, the authoritative-intrinsic value-oriented parent, is oriented on the needs and emotions of the animal. The second one, namely the authoritative-training oriented parent, is mostly oriented on training and teaching the dog how to behave and function in our society. A permissive or uninvolved parenting style was not found, which the researchers attribute to the study population of devoted dog owners. Eventually, a Dog-Directed Parenting Styles and Dimensions Questionnaire (DD-PSDQ) was created.

Parenting styles are found also in the owner-dog relationship, raising questions about its consequences for the well-being of dogs. One way of investigating welfare of animals is through exploring their optimism bias. An optimism bias is an interesting psychological phenomenon where individuals overestimate the likelihood of positive events, while underestimating the likelihood of negative events. The bias is defined as the difference between an individual's expectations and the outcome that follows. When the expectations are better than reality, the bias is optimistic. When reality is better than expected, the bias is pessimistic. Thus, the extent of the optimism bias can be measured by recording a person's expectations before an event unfolds and contrasting that with the outcome. Thus, students expect higher salaries and more job offers than they end up getting, people expect to experience greater pleasure from vacations than they actually do, and people anticipate more positive events in the upcoming month than we end up experiencing (Sharot, 2011). This optimism bias is also reported in non-human animals, suggesting it is a trait shared by multiple species. To study optimism bias in European starlings, Matheson et al. (2008) taught eight birds to discriminate between two auditory stimuli. They were trained to press a red lever when they heard a short tone in order to receive an immediate reward, and a green lever when they heard a long tone to receive a delayed reward. The birds preferred the short tone, since the immediate reward is considered a positive outcome compared to the delayed reward associated with the long tone. They then presented an intermediate cue in the form of a medium length tone. The results reveal that a large percentage of the birds chose to press the red lever, associated with the immediate reward. This suggests that they expected a positive outcome even though they had no objective reason to do so, showing an optimism bias. Interestingly, the birds that were kept in sub-optimal housing conditions did not show this optimism bias. Their actions indicated that their expectations were unbiased rather than optimistic. Comparable results have also been found in a study by Harding et al. (2004). They discovered that rats housed in unpredictable conditions showed a more pessimistic response bias than rats housed in predictable conditions. In dogs, separation-related behaviour related directly to a 'pessimistic' optimism bias (Burman et al., 2011). Thus, depressed or anxious individuals seem to show a reduced expectation of positive events and interpret ambiguous stimuli as neutral or even negatively, meaning that the optimism bias is influenced by the affect or emotional state of an animal. A lack of optimistic bias has also been reported in humans, where individuals suffering from depression appeared to be unbiased or, in case of severe depression, even exhibited a pessimistic bias (Strunk, Lopez, & DeRubeis, 2006). If the optimism bias can be used as an indicator for the affective state of an individual, this could provide a novel, non-invasive technique to measure animal welfare. The test used to measure an animal's optimism bias is called the cognitive bias test. Specifically, this test measures a test subject's expectancy regarding an ambiguous stimulus that is intermediate between a previously rewarding stimulus and non-rewarding stimulus. For this research, the previously developed spatial task by Burman et al. (2011) was adopted and adjusted by looking into different protocols from various researchers (Burman et al., 2011; Duranton & Horowitz, 2019; Kis, Hernádi, Kanizsár, Gácsi, & Topál, 2015; Starling, Branson, Cody, Starling, & McGreevy, 2014). The optimism bias has been shown to be a reliable indicator of the valence (positivity or negativity) of an animal's affective state (Burman et al., 2011; Harding et al., 2004; E. S. Paul, Harding, & Mendl, 2005). Thus, by measuring a dog's optimism bias, it is possible to indirectly investigate their mental state and well-being.

Dog-directed parenting styles are likely to impact on dog well-being, but so far this has not been investigated, which is unfortunate as parenting style could be used to promote dog welfare. This research aims to test the relationship between different dog-directed parenting styles and the optimism of dogs as a proxy for their welfare. The parenting style of the owners will be examined using a questionnaire based on the questionnaire developed by van Herwijnen et al. (2018). The cognitive bias test will be utilized to test the optimism bias of the dogs, and by extent, their mental state. Two different versions of the test will be optimized and compared. The hypothesis is that owners with authoritative parenting styles have more optimistic dogs, while owners with an authoritarian parenting style have more pessimistic dogs.

2 MATERIALS AND METHODS

This study aims to investigate a possible association between dog-directed parenting styles and optimism bias in dogs. To accomplish this, an online questionnaire was filled in by 223 dog-owners. Seventeen of these questions inquired about the owners' parenting style, while the other 16 items questioned how the owners estimated their dogs' optimism. Afterwards, 34 of those dog-owners were invited to Carus at Wageningen University and Research to take part in several behavioural tests. These tests consisted of two different versions of the cognitive bias test and a food motivation test.

2.1 QUESTIONNAIRE

To investigate the relationship between parenting styles and the optimism bias of dogs, a questionnaire, consisting of three main sections, was constructed and publicized in the Netherlands through Facebook, online advertisements and flyers. The first section was developed by Mike van Dijk and focuses on the parenting style of the dog owners. The questions for this section were in part drawn from the 32-item Parenting Style and Dimensions Questionnaire (PSDQ; (C. C. Robinson et al., 1995), which was adapted to dog owners. The other part originated from the dog-directed PSDQ, developed by (van Herwijnen et al., 2018). Lastly, two extra questions were added to target the uninvolved and permissive parents specifically. This resulted in 17 items, listed in Appendix I. The second section of the questionnaire centers around the owners' estimation of their dogs' optimism. This was done by listing 8 keywords associated with optimism and 8 keywords related to pessimism (

Appendix II). The owners were asked to score their dogs on a 5-point Likert scale, depending on how they found the word appropriate in describing their dog. If the average score for the words associated with optimism was higher than the average score for the words associated with pessimism, the dogs were categorized as optimistic, and vice versa. The owners were also asked directly if they would describe their dog as optimistic or pessimistic by posing the question "If you consider the saying "the glass is half full or half empty", is the glass for your dog then A) half full or B) half empty?". Both these methods were then later used as a standard to estimate if the optimism score from the Cognitive bias tests were accurate. In the third section, some general information about the owner and their dog (i.e. age, gender, breed) was collected. The questionnaire was completed by 223 dog owners, of which 190 were female and 33 were male. The owners' dogs (n = 223; 102 male / 121 female) were of different breeds.

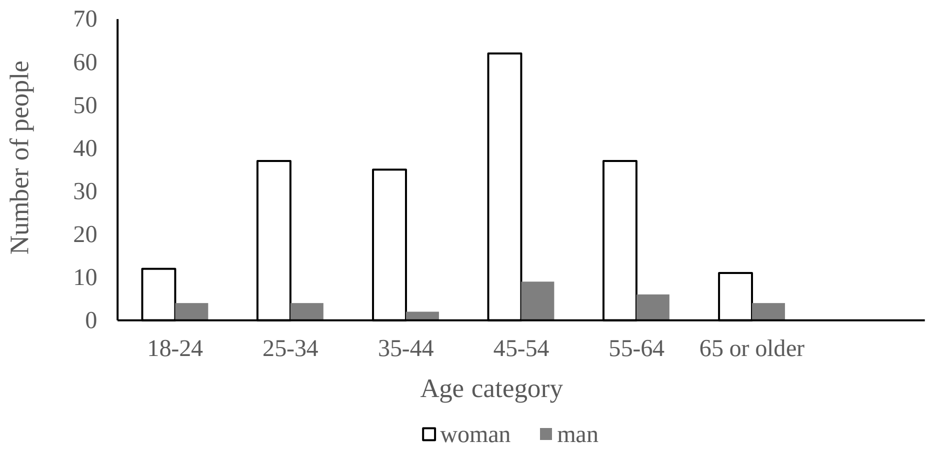

Figure 2. Overview of characteristics of dog owners participating in the questionnaire.

2.2 BEHAVIOURAL TESTS

Thirty-four owners and their dogs were invited to Carus Research facility to take part in two different versions of the Cognitive bias test and a food motivation test. The dogs' degree of optimism was measured using the Cognitive bias test, which measures a test subject's expectancy regarding an ambiguous stimulus that is intermediate between a previously rewarding stimulus and non-rewarding stimulus. The previously developed spatial task by (Mendl, Brooks, et al., 2010) was adopted and adjusted by looking into different protocols from various researchers.

The testing area was the same for all participating dogs and contained two cameras, positioned so that the dog and owner were visible at all times (Figure 1). Throughout the test, the owner and two experimenters were present. To mask noises from neighboring rooms, classical music was played in the background during the tests. Two versions of the cognitive bias test were performed on each dog to compare efficiency and quality of the different versions. The sequence in which they performed the two versions of the test was randomly assigned, as well as the position of the positive and negative bowl. Randomization for all the experiments was done using Python 3.7.4 (

Appendix III).

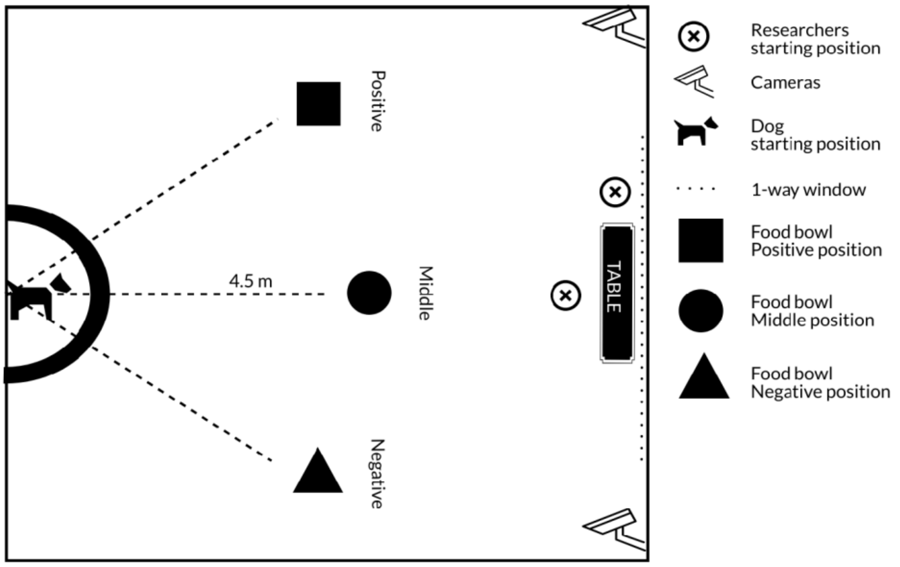

Figure 3. Set-up for the cognitive bias test. A schematic overview of the testing area at Carus, Wageningen University and Research. The square represents the positive cue (reinforcing event), while the triangle represents the negative cue (aversive event). The reinforcing event was a bowl with a food reward inside, while the aversive event was the lack of food in the bowl. In case of test version 2, this was in combination with subsequent trials being negative. the bowl in the middle served as the intermediate event. The bowls were all at 4,5 m distance from the dog and the distance between the bowls was 2.3 m.

On the day of the test, owners were asked not to feed the dogs for at least one hour prior to testing to ensure sufficient food motivation. The procedure started with the experimenter explaining the course of action. Owners were also asked to sign a form agreeing to being filmed throughout the tests. This video footage would only be used for scientific research within the University of Wageningen. After this, the owners were asked to put their own collar or harness and a short leash on the dog and to enter the test room. Once entered, the dogs were habituated to the area and the experimenters for five minutes, during which the dog was allowed to explore the room and interact with the experimenters. After five minutes, the owner was asked to attach the dog to the 4.5 m leash secured to the wall and to detach their own leash.

The first phase of the cognitive bias test started immediately after the 5-minute habituation period. Owners were instructed to stand on a marked X and to position the dog next to them inside the marked circle, orienting the dog towards the bowls. One of the experimenters stood aside to keep track of the trial sequence and to time the latencies the dogs needed to approach the food bowl. The experimenter tasked with positioning the bowls stood in front of the table. Depending on the trial sequence, they would bait the bowl with the dog’s preferred treat, or leave the bowl empty, operating with similar motions to prevent the dog from seeing if the bowl was baited. The quantity of the food reward was adjusted depending on the size of the dog to prevent them from getting satiated before the tests were finished. The experimenter put the bowl at 4.5 m in front of the dog on either the positive or the negative mark. The bowl had a false bottom to prevent the dogs from distinguishing a baited bowl from an un-baited bowl by smell. The food bowl was put in different locations (left or right) depending on the trial sequence. The experimenter instructed the owners to remain silent while the dogs were conducting a trial, as this could affect the results. Before the test started, owners were asked to release the dog with the same command for each trial and to only say it once. If at any moment during the test the owners started repeating the command during the trial, they were corrected by the experimenter. At each start of a trial, the owner was asked to hold the lead at the marked point so the dog could not run towards the experimenter or locations. When the experimenter had returned to the table, with his or her back to the dog, she signaled the owner by saying: “You may release your dog”. Once the dog had eaten the treat (positive location) or had seen that the bowl was empty (negative location), the owners were instructed to recall the dog. After this, the experimenter would remove the bowl and return it to the table.

Both tests consisted of 3 phases in total. For both versions, Phase I consisted of five mock trials, in which the dog was encouraged to check a baited bowl for a food reward. This was done at the side of the positive location. Consecutively, the bowl was placed at 1m, 1.5m, 3m, 3.5m and 4.5m from the dog (Table 7,

Appendix I). The experimenter visibly dropped the food in the bowl to encourage the dog to check the bowl. No latencies were recorded for this phase. After completing these five training trials, the dog immediately continued to Phase II. During this phase, the dogs were trained to differentiate between the positive position (with a reinforcing event) and the negative position (with an aversive event). This was done by alternating the location of the bowl between the positive and negative location. For the first version, the sequence was determined pseudo-randomly (Python 3.7.4), with no more than two negative trials being presented consecutively. The phase consisted of 18 trials in total, of which 10 were positive and 8 were negative (for an example see Table 8,

Appendix I). The latencies to approach the bowls were recorded for all 18 trials. After completing these trials, the dog continued to phase III. The sequence for the second version was variable and was determined by how the dog reacted to the negative event. The initial trials were randomized until the dog received a negative trial. If this negative trial was unsuccessful, the dog received a subsequent negative trial. A negative trial was unsuccessful when the dog started going towards the negative location in under 6 seconds or if it took them less than 10 seconds to reach the negative location. If the dog was successful (the dog took longer than 6 seconds to start running, or took longer than 10 seconds to reach the negative bowl) a positive trial followed. After every positive trial, a negative trial followed to prevent the dog from getting to enthusiastic again. This sequence was repeated until the dog reached the learning criterium. The learning criterium was set on the dog having 2 consecutive successful negative trials. After reaching this, the dogs proceeded to Phase III. For version 2, Phase II consisted of a maximum of 30 trials, but was variable if the dog reached the learning criterium earlier (see Table 9,

Appendix I). If the dog did not reach the learning criterium within 30 trials, it proceeded to phase III after the 30th trial. Latencies to approach the bowls were recorded for all trials.

Phase III was the actual testing phase. For version 1, there were two possible sequences, one where the penultimate trial was positive and one where it was negative (see Table 10,

Appendix I). These different sequences allow us to investigate the possible effect of the location of the next to last trial on the latency to approach the middle location. The sequences were assigned to the dogs randomly using Python 3.7.4. For version 2, the sequence of trials was set (see Table 11,

Appendix I), because every positive trial was always followed by a negative trial. If the ambiguous cue was presented after a positive trial, it could cause biased results. Lastly, the ambiguous cue was presented, i.e. the bowl was placed in the middle position. Latencies to approach the bowls were recorded for all trials.

The readout parameter during the trials was the latency to reach the position, which was measured as the time between the dogs receiving their release command and the dogs putting their nose in the food bowl. The latencies were timed during the test and reported on a form (

Appendix V), after which the latencies were validated by re-watching the video footage. If the dog failed to reach the bowl within 10 seconds, the trial ended and a latency of 10 seconds was recorded. If the dog did not start running towards the bowl within 6 seconds, the trial was ended and a latency of 10 seconds was recorded as well.

After finishing the two versions of the Cognitive bias test, each dog also performed a test to measure their food motivation. The results from the Cognitive bias test could be influenced by how food motivated the dogs are. The food motivation test was introduced after the second cognitive bias test to have a quantitative measure of that motivation. A commercial puzzle toy with their preferred food inside was presented to the dog. The dogs were then timed to see how long they interacted with the toy to obtain the food. The toy was provided for 30 second before it was taken away.

2.3 Statistics

Cognitive bias outcomes of this research were pooled with those of previously executed tests. In total, 170 dogs were tested for optimism using 9 different versions of the cognitive bias test (CBT). Ninety-two test subjects participated in one test, while 156 participated in two tests. This resulted in a total of 248 tests. The data set was analysed with linear mixed models by a restricted maximum likelihood (REML) procedure. A random component took into account the repeated measures per dog and a total of 4,220 records were analysed with following statistical model:

$$y_{nopq} = \mu + test_n * position_o * trial\_within_p + dogID_q + \epsilon_{nopq}$$

with y representing the latency to approach the bowl for the dog q (n = 170) during trial p (variable depending on test), with position o (positive, negative) in cognitive bias test version n (9 different protocols). The overall mean is represented by μ and the residuals are represented by ϵ. Interactions between the fixed effects were analysed. The prediction was that the latency towards the positive treatment would decline, while the latency for the negative treatment would incline, depending on the test protocol. Subsequently, there should be a larger difference between the latency for the positive and negative in the last trials than in the first. This was evaluated by looking into the three-way interaction effect between test, position and trial, the two-way interaction between position and trial and the main effect for position. A significant three-way interaction effect would indicate that, depending on the test, the dogs discriminated between the positive and negative location. If the two-way interaction effect is significant, the dogs still discriminate between positive and negative, but not depending on the test. A significant main effect of position indicates that the difference between positive and negative is already clear from the start. The predicted means for the different versions of the cognitive bias test were plotted to compare the progress of the different versions. The statistical model was adapted slightly, by replacing the fixed effect ‘test’, for the purpose of evaluating the effects of repetition of the test (first test or second test) and the effect of the previous bowl position (positive or negative).

Following the general analysis of the cognitive bias tests, the versions used in this research were examined more closely. Throughout this research, the optimism bias of 28 dogs was tested using 2 different cognitive bias procedures. All dogs participated in the two versions, resulting in 56 tests. Version 1 of the cognitive bias test included 22 test trials, including 12 positive and 9 negative trials. For version 2, a variable number of test trials was investigated. The data was analysed with the same restricted maximum likelihood (REML) by use of a linear mixed model as mentioned before. A spline function was also added to check on the validity of a linear function for describing learning effects. A total of 1,064 records on 28 dogs were analysed with the statistical model as described with 'test' representing version 1 or 2 and trials ranging from 1 to 26. As described, the fixed effect 'test' was then replaced to evaluate the effect of repetition (first test, second test). Statistical analyses were done also per dog, as to determine which of the dogs discriminated between the two bowl positions and for this the following ANOVA model was used:

$$y_{op} = \mu + position_o * trial\_within_p + \epsilon_{op}$$

where y is the latency to approach the position o of the bowl (positive, negative) during trial p (variable depending on the test). The tests that showed a trend for the two-way interaction between position and trial or for the main effect of position (P-value < 0.1) were selected for calculating optimism scores.

To assess subject's optimism bias for the ambivalent trial, and to control for the high individual variation in running speed, a Positive Expectancy Score (PES) was determined as follows:

$$PES = 100 - CBS \quad and \quad CBS = \frac{M - P}{N - P} * 100$$

with M being the latency to approach the middle location, P being the latency to approach the positive location and N being the latency to approach the negative location. The PES was calculated using different methods for acquiring the positive and negative latencies. The first method was based on the last measure for both the negative and positive position. The second method employed the average of the last three trials for both the negative and positive position, and the last method was based on the predicted means of trial 10, obtained from the ANOVA analyses, for both the negative and positive position. Correlations were calculated between all three methods. Two thresholds were employed for deeming a dog optimistic to compare the most accurate method. Dogs with an optimism score (PES) of over 50 were considered optimistic, compared to dogs with an optimism score higher than the mean. The CBS refers to the adjusted cognitive bias score used by Mendl et al. (2010), where higher PES values relate to a more optimistic bias, while lower PES scores are indicative of a more pessimistic bias. When the latency for the ambivalent location is in between the latency to the negative and to the positive location, the value of the PES falls within 0-100 interval (if M > N, the PES was cut off at 0; if M < P, the PES was cut off at 100; if N > P it was counted as an error). If a dog understood both tests, the mean optimism score was calculated and this score was used in further analysis. The correlation between two optimism scores when a dog understood both tests was calculated for the three methods (last measure, average of the 3 last measures and predicted mean for trial 10) as a measure for the repeatability of the cognitive bias test.

To test if the questionnaire measured the same parameter as the cognitive bias tests, the specificity and sensitivity were calculated. The owner reported assessment of their dogs' optimism was considered an accurate representation of reality (the golden standard). The optimism scores (PES) were compared to this. Two methods were employed to question the owners' assessments of their dogs' optimism. One of these methods, considered the golden standard, outright asked the owners to report the dog as optimistic or pessimistic. The newly developed method questioned the dogs' optimism through listing 16 key words associated with optimism and pessimism. The new method of questioning the owners' assessments of their dogs' optimism was also analysed for specificity and sensitivity.

Lastly, the association between the optimism and the parenting styles was evaluated using Pearson correlation. The scores for the parenting styles were calculated by averaging answers, which were expressed on a 5-point scale. The following formula was used:

$$PSS = \frac{sum\ of\ question\ scores}{maximum\ score\ per\ question * answered\ questions}$$

Statistical analyses were performed using Microsoft Excel, Genstat and R. Effects were considered of interest when these has a P-value of 0.1 or lower.

3 RESULTS

3.1 COGNITIVE BIAS TEST

The optimism bias of dogs (n = 170) was tested using 9 different versions of the cognitive bias test, totalling 248 tests. In total, 4,330 records were analysed with a REML for fixed effects of Test (9 possibilities), Position (Positive or Negative), Trial (variable depending on the test) and the interactions between these three. The overall predicted mean latency for the dogs was 3.22 ± 0.28s, with the predicted mean latency to contact the positive bowl 2.67s and 3.78s for the negative. The 9 different versions of the CBT protocols differed for spatial discrimination across trials as evident from a significant three-way interaction (P-value = 0.015) for Test, Position and Trial, indicating that depending on the version of the test the dogs discriminated differently between the positive and negative position over the trials.

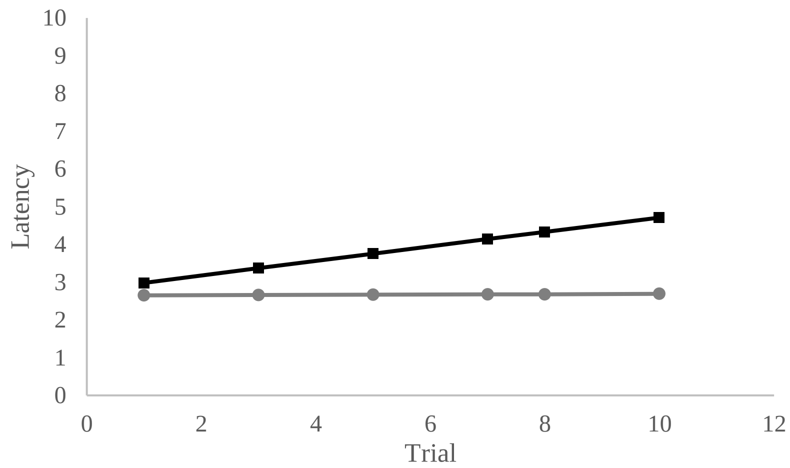

Figure 4. Dogs (n = 170) were tested for optimism using 9 different protocols of the cognitive bias test. A graphical display of the latencies to reach the positive (black squares) and negative (grey dots) position for the training trials for all the protocols.

Next, the cognitive bias test versions were analysed separately by plotting the predicted means per test, bowl position and trial (

Figure 5). The three spatial tests (A, B & C), done by 3 individual experimenters, show an overall noticeable difference in latency between the positive and negative position. Compared to the spatial tests, the tests based on size discrimination (D, E & F) barely show a difference between the two positions. Tests with added aversiveness (F & G) show that the dogs also discriminated between the positive and negative position. The tests done specifically in this research (A & G) will be examined further.

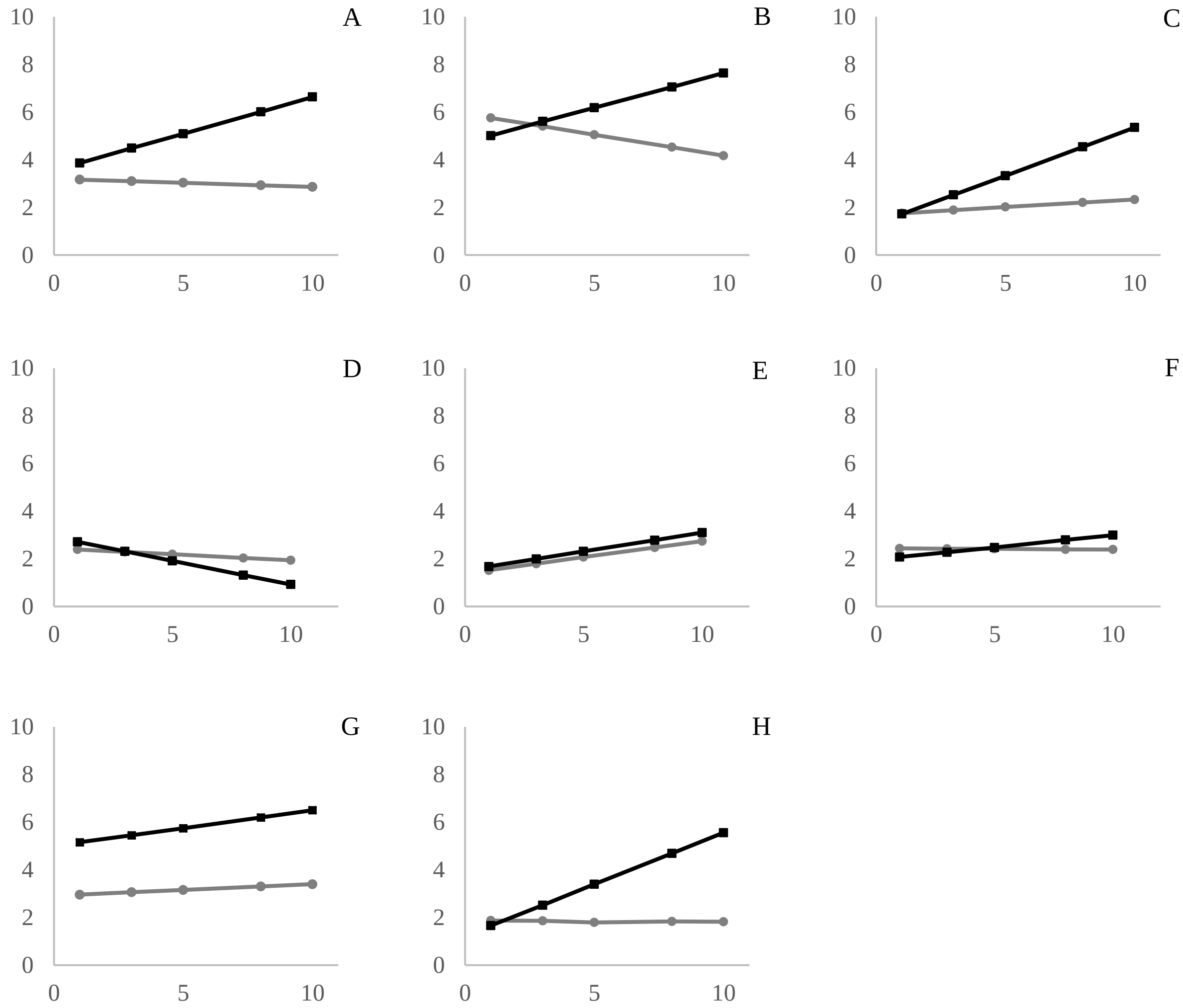

Figure 5. Dogs (n = 170) were tested for optimism following 9 different protocols. The differences in latency between 8 of these protocols are shown (3-way interaction with p-value = 0.015). The tests with spatial discrimination (a = spatial discrimination - Hannah, b = spatial discrimination - Pascal, c = spatial discrimination - Marielle, g = spatial discrimination + subsequent negative trial, h = spatial discrimination + light aversion) exhibit the largest difference in latency between the positive (grey dots) and negative position (black squares). The tests with size discrimination (d = size discrimination + extra treat, e = size discrimination + light aversion, f = size discrimination) showed little to no difference between the two positions. Tests with an added aversiveness to the negative position (g = spatial discrimination + subsequent negative trial, h = spatial discrimination + light aversion) also showed a pronounced difference in latency between the two positions.

Next, the 4,220 records were analysed for the potential effect of repeating testing. A REML for the fixed effects: Phase (One, Two), Position (Positive, Negative), Trial (variable depending on the test) and interactions between these three was performed. Repetitions did not affect the outcomes and both the interaction effect with Phase (P = 0.955) and its main effect (P = 0.305) were not significant. Similarly, the effect of the previous position was examined. A significant 3-way interaction effect (P = 0.007) was found, where the latency to reach the negative position when the previous position was negative was significantly higher than when the previous position was positive and increasingly so over time (**Error! Reference source not found.**). Subsequently, the effect of the previous position on the middle position was also investigated. Twenty-eight records were analysed, where the mean latency to reach the middle position with previous trial positive was 3.16s and the mean latency to reach the middle position with previous trial negative was 2.42s (t-test, equal variance assumed, one-tailed P-value = 0.143).

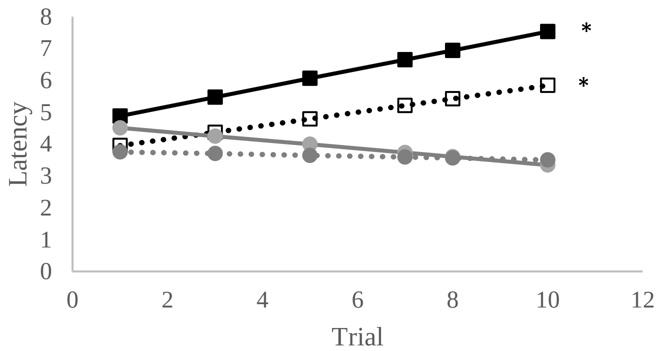

Figure 6. Visual representation of the differences in latencies between the negative and positive position when the previous position was either negative or positive (3-way interaction with p-value = 0.007) with filled black = negative trial with previous position negative, dotted black = negative trial with previous position positive, dotted grey = positive trial with previous trial positive, filled grey = positive trial with previous position negative. The latency to reach the negative position differed significantly between the previous position being positive and the previous position being negative.

Following the overall analysis of the cognitive bias test, the two versions of the cognitive bias test performed by me were analysed more closely. Test subjects (N = 28) participated in both versions, resulting in a total of 56 tests. For both tests, all trials were analysed (version 1: 21 trials, version 2: variable number). Thousand sixty-four records were analysed with a REML with added spline function for Trial (1 to 26) and the further fixed effects Test (version 1, version 2), Position (Positive, Negative) and all interactions. The predicted mean latency for all the dogs was 4.45 ± 0.27 s. A significant two-way interaction effect between the position and trial (P < 0.001, Figure 7) was present, indicating that the dogs discriminated between the two positions and increasingly so over time. Across trials, the difference in latencies towards the positive position (3.28 s) and negative position (5.97 s) was 2.7s. The different CBT protocols did not cause different discrimination learning (P-value for the 3 way-interaction = 0.803) and the two versions worked similar.

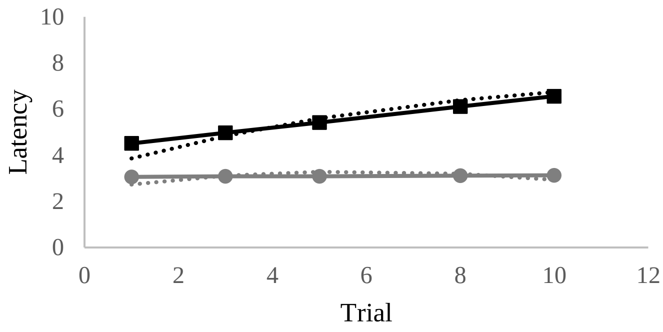

Figure 7. Dogs (n = 28) were tested for optimism using 2 different protocols of the cognitive bias test. The differences in latency to reach the positive (black squares) and negative (grey dots) position between the linear (full line) and the spline (dotted line) function are shown.

The analyses with Trial effects fitted as a spline function seemed to deviate somewhat from when Trial wat fitted linearly and for this reason the two CBT versions were compared in more detail by plotting the predicted mean latencies (see **Error! Reference source not found.**). For version 2, the spline function clearly deviated from a linear function, portraying the progress of the test more accurately. For both tests, the dogs discriminate between the positive and negative location, with no major differences in mean latency (version 1: 4.41 ± 0.28; version 2: 4.85 ± 0.31). However, dogs in version 2 seems to progress much faster in the first trials, with the predicted mean latencies for the negative location increasing from 4.10s in the 1st trial to 6.57s in the 7th trial. After that, the latency for the negative position seems to plateau. In version 1 on the other hand, it seems that dogs needed 10 trials to reach a latency of 6.24s for the negative location. For version 2, the latency to approach the negative location in trial 10 was around 7.24s. Noticeable is also that in version 2 the latency towards the positive location gradually increased. On average, the dogs took approximately 18.75 trials to reach the learning criterium for version 2, similar to the 18 trials used in version 1.

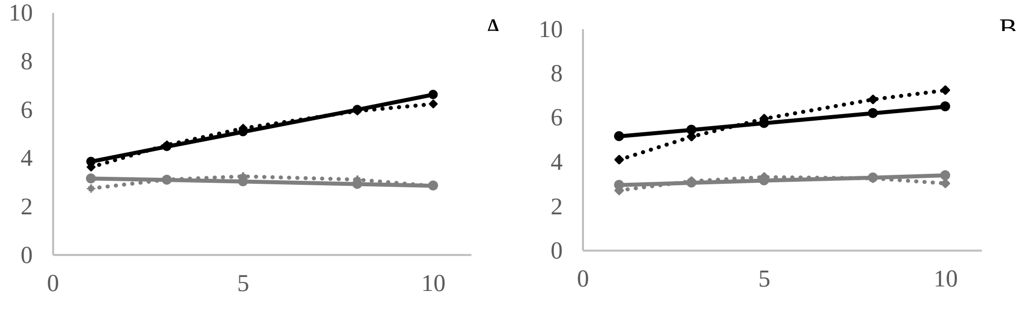

Figure 8. Dogs (n =28) were tested for optimism using 2 different versions (a = version 1, b = version 2) of the cognitive bias test. the differences in latency to reach the positive (black squares) and negative (grey dots) position between the linear (full line) and the spline (dotted line) function are shown. For version 2, the spline function shows a non-linear function. As such, for both versions, analysis was done with the spline function.

Since all the dogs did the cognitive bias test twice, the effect of repetition was also investigated. A REML for the fixed effects: Phase (One, Two), Position (Positive, Negative), Trial (1 to 26) was performed on 1,064 records. There was no significant 3-way interaction effect (P = 0.482), but there was a significant 2-way interaction effect for Phase and Position (P < 0.001, see Figure 9). Specifically, the latency to reach the negative position was significantly higher in the second phase than in the first phase, indicating that dogs learned with repetition. Subsequently, the effect of repetition on the middle position was also investigated. Fifty-six records were analysed, where the mean latency to reach the middle position in the first test was 3.19s and the mean latency to reach the middle position for the second test was 3.31s (t-test, equal variance assumed, one-tailed P-value = 0.423).

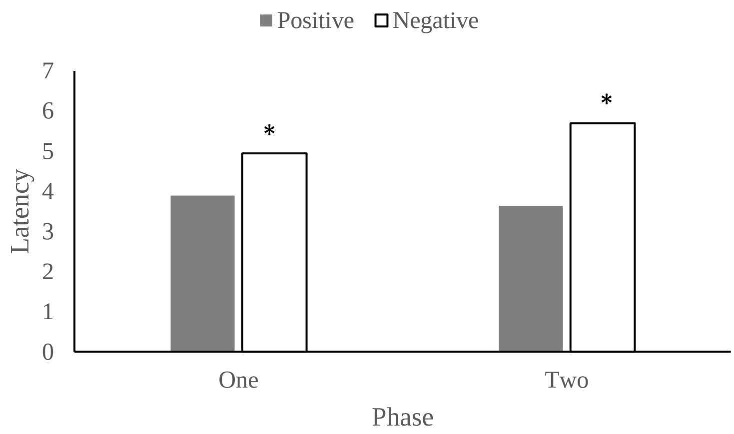

Figure 9. Visual representation of the differences in latencies (2-way interaction with p-value < 0.001) between the negative and positive position for phase one and phase two. The latency to reach the negative position differed significantly between the first phase and the second phase.

After the dogs participated in the two cognitive bias tests, they did a food motivation test. Dogs (N = 14) were presented with a food toy and timed for how long they showed interest in it. After 30 seconds the toy was removed. The average time spent on the dog toy was 26.36 with 11 dogs showing interest for the full 30 seconds. This indicates that food motivation does not seem to be a limiting factor for participation in the test.

Next, for every test performed by a dog the trials were analysed with ANOVA. The latencies to reach the positions were analysed for effects of Position, Trial and interactions. A trend ($P < 0.1$) for the two-way interaction effects or for the main position effect were assumed to indicate that dogs effectively discriminated between the positive and negative position. Figure 10 shows an example of a dog that did (B), and one that did not (A).

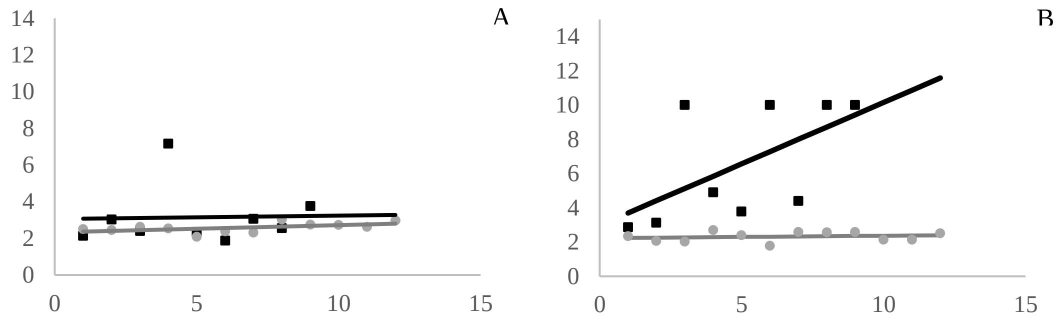

Figure 10. Examples of a dog that misunderstood the cognitive bias test (a) and a dog that understood the test (b). Raw data of the latencies to reach the positive (grey dots) and negative (black squared) position during the training trials are shown. The predicted means of the ANOVA analysis are shown in the form of linear lines. For a, no difference in latency for the positive and negative position is visible, suggesting that the dog did not discriminate between the two positions (2-way interaction p-value = 0.788). For b, a clear difference in latency for the positive and negative position is visible, suggesting that the dog discriminated between the two positions (2-way interaction p-value = 0.024).

Eventually, 32 out of 55 cognitive bias tests were understood by dogs. For version 1, 19 dogs discriminated out of 27 tests, while for version 2 only 13 discriminated out of 28 tests. A Chi-square test showed no significance, but did show a trend (P-value = 0.0719).

Table 1. Understood and misunderstood tests for version 1 and version 2 of the cognitive bias test (contingency table for the chi-square test with residuals between brackets).

Test	***Understood***	***Misunderstood***	***Total***	***Percentage of understood***
Version 1	19 (0.8)	8 (-1.0)	27	70.37
Version 2	13 (-0.8)	15 (1.0)	28	46.43
Total	32	23	55	58.18

3.2 OPTIMISM SCORES

For the dogs that understood at least one test (n=23), optimism scores (PES) were calculated (for details see methods). The PES was calculated using 3 different methods for acquiring the positive and negative latencies. Two PES thresholds were employed for deeming a dog optimistic.

Table 2. An overview of the methods to calculate the optimism score (PES): last latency measure, average of the 3 last measures, predicted means for trial 10; employing two different thresholds: optimistic when over 50 out of 100 and optimistic when higher than the mean.

	Last measure		***Average of 3 last measures***		***Predicted means trial 10***	
PES threshold	PES > 50	PES > Mean	PES > 50	PES > Mean	PES > 50	PES > Mean
Optimistic	21	11	18	14	20	17
Pessimistic	2	12	4	8	3	6
Total	23	23	22	22	23	23

As noticeable in Table 2, the threshold of higher than 50 out of 100 labelled much more dogs optimistic than the threshold of the mean. Comparing this to the golden standard, the owners' own assessment of their dogs' optimism, the threshold of 50 was more accurate. The correlations between the three different methods of calculating the optimism score can be found in Table 3. Correlations with the Predicted mean based on trial 10 were the lowest and the correlation between the Average of the 3 last measures and the Last measure were the highest.

Table 3. An overview of the correlations between the 3 methods employed to calculate the optimism scores.

Methods	***Pearson correlation coefficient***
Average of last 3 measures – Last measure	0.840
Average of last 3 measures – Predicted mean trial 10	0.798
Last measure – Predicted mean trial 10	0.613

The correlation between the two optimism scores of the dogs that understood both tests were calculated (Table 4). This is a rough measure for the repeatability of the cognitive bias test, taking into account that the two tests had different protocols. The correlation between the 2 optimism scores was highest when calculated with the Average of the last 3 measures. Eventually, the optimism scores calculated based on the Average of the 3 last measures were used in further analyses.

Table 4. An overview of the correlations between 2 optimism scores of 1 dog, as measurement for the repeatability of the cognitive bias test.

Method	***Pearson correlation coefficient***
Last measure	0.670
Average of last 3 measures	0.686
Predicted mean trial 10	0.485

Owner reported optimism was questioned in two ways. The first method was by posing the question “If you think about the saying “the glass is half full or half empty”, is the glass for your dog then 1) half empty or 2) half full?”. The answer was either “half full” (optimistic) or “half empty” (pessimistic). This was used as the golden standard, serving as true data. Two-hundred six owners considered their dog optimistic, while only 17 considered them pessimistic. The other method that I used was by listing 16 key words listed in Appendix II. These scores were translated into dogs being either optimistic or pessimistic. They were then evaluated for sensitivity and specificity against the golden standard. Ninety-eight percent of the dogs were correctly identified as optimistic, while 53% were correctly identified as being pessimistic.

Table 5. The sensitivity and specificity between the survey golden standard for questioning optimism and the newer method of listing 16 keywords.

Golden standard	***Optimistic***	***Pessimistic***
New method		
Optimistic	199 (True positive)	7 (False positive)
Pessimistic	5 (False Negative)	8 (True negative)
Sensitivity	**0.98**	
Specificity	**0.53**	

The optimism scores could not be evaluated for sensitivity and specificity since there was not enough data. None of the dogs that had an optimism score were considered pessimistic by their owner (in either method), which made it impossible to calculate the specificity.

3.3 Parenting styles

The different parenting style scores and their dimensions were calculated with the questions from the survey. Participants were mostly characterized by high scored authoritative-intrinsic (AUTVI, μ = 2.14 ± 0.74 on a scale of 0 to 4) and authoritative-training (AUTVT, μ = 3.16 ± 0.72), the dimension of responsiveness (μ = 67.86) and to a lesser degree the PSDQ styles authoritative (AUTV, μ = 1.7 ± 0.83) and permissive (PERM, μ = 1.73 ± 0.85). Participants scored lowest for PSDQ authoritarian (AUTN, μ = 0.39 ± 0.59).

Table 6. Dog owners' (n = 223) 17-item PSDQ scores based on a five-point Likert scale. scores are presented as mean ± std. dev. for the dimensions (responsiveness and demandingness), the parenting styles of the original-PSDQ (PS) and dog-directed PSDQ (DD-PS).

Dimensions	***Mean ± Std. Dev***	***Median***	***Min - Max***
Responsiveness	3.39 ± 0.78	3.63	0 – 4
Demandingness	2.80 ± 0.44	2.71	0 – 4
PS			
Authoritative (AUTV)	1.70 ± 0.83	2.00	0 – 4
Authoritarian (AUTN)	0.39 ± 0.59	0.00	0 – 4
Permissive (PERM)	1.73 ± 0.85	1.50	0 – 4
Uninvolved (UNINV)	1.02 ± 0.94	0.75	0 – 4
DD-PS			
Authoritative-intrinsic (AUTVI)	2.14 ± 0.74	2.50	0 – 4
Authoritative-training (AUTVT)	3.16 ± 0.72	3.50	0 – 4
Authoritarian- control (AUTNC)	0.93 ± 0.50	0.50	0 – 4

Lastly, the relationship between the optimism scores and the parenting style scores for 23 participants was investigated by Pearson correlation. No significant correlations were found. A trend (r = -0.31, one-sided P-value < 0.1) for a negative correlation between the demandingness score and the optimism scores was discovered (

Figure 11). This indicates that the higher the demandingness an owner exhibits, the lower the optimism score for the dog is.

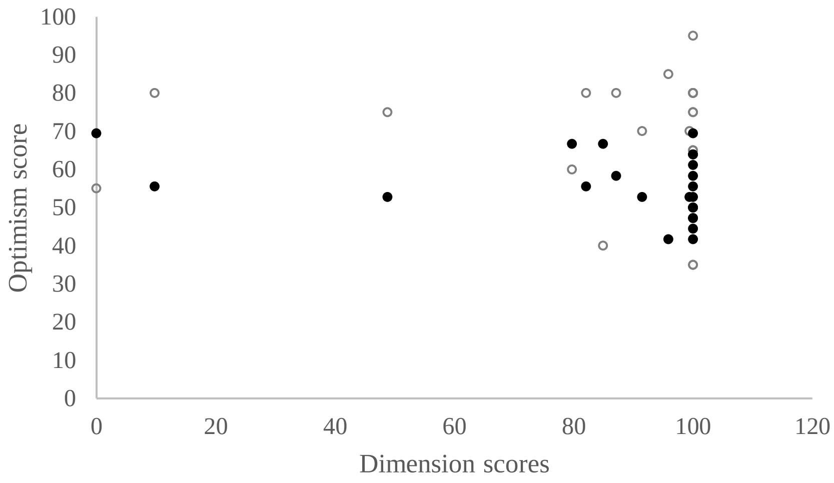

Figure 11. The relationship between the optimism score and the scores for the dimensions of the parenting styles (demandingness: filled dots; responsiveness: open dots). A trend was found for the negative correlation between the optimism scores and the demandingness (r = -0.31, one-sided p-value < 0.1).

4 DISCUSSION

Optimism associates with well-being in both humans and animals, meaning it can be used for welfare assessment. The present study measured optimism in dogs, by applying the cognitive bias paradigm, and tested it for association with owner dog-directed parenting style. In humans, the combination of parental responsiveness and demandingness has the most favourable outcomes on child well-being, but among the 28 study dogs there was only a weak ($P<0.1$) inverse relationship between demandingness and optimism. Independent of an owner's responsiveness the load of parental demand put on a dog may bring about pessimism and suboptimal dog welfare.

The dog-directed parenting styles and basic dimensions were measured with an online questionnaire and these self-report based scores for owners were correlated to optimism scores that were based on the cognitive bias tests with the dogs. Over the years, various cognitive bias protocols have been developed for a wide range of species. Despite all of them being focused on measuring optimism bias, there is considerable variation between studies, including the type of discriminative stimulus, the consequences for the positive and negative cue, the treatment, the dependent variable, the number of presentations of the intermediate cue and the statistical analyses. For example, various discriminative stimuli have been tested, including visual, auditory, olfactory and spatial cues. Discrimination based on visual cues has mostly been done in research with birds, including a study by Matheson et al. (2008) on starlings where they trained the birds to discriminate between 2 light stimuli with different duration, i.e. 2s versus 10s. Deakin et al. (2016) subjected chickens to a screen-peck task, where hens were taught to discriminate between a high saturated orange circle and a low saturated circle on a computer screen. Examples of auditory based tests include a study by Harding et al. (2004), who taught rats to discriminate between two auditory cues (for a similar study with pigs, see Douglas et al. (2012). Olfactory cues have also been used, albeit less often. Mice, for example, were trained to distinguish between two odour cues (vanilla and apple) that predicted either a palatable or an unpalatable food (Boleij et al., 2012). A similar tactic was employed with honey bees (Bateson, Desire, Gartside, & Wright, 2011). Cues based on spatial discrimination are used most frequently, and examples include studies by Baciadonna (2016) on goats, by Henry (2017) on horses, by Düpjan (2013) on pigs, by Wichman et al. (2012) on chickens, by Kloke et al. (2014) on mice and by various researchers in dogs (Burman et al., 2011; Duranton & Horowitz, 2019; Müller et al., 2012). Combinations of different modality cues are possible and might even be better suited for some species. Different positive and negative outcomes of choices have also been employed, which is likely to be important considering that reward and punishment have been shown to be important modulators of animal behaviour (Kelleher & Gollub, 1962). The positive outcome is mostly characterized by a food reward, but variations exist. In a research by Verbeek et al. (2014) for example, they used access to conspecifics as a rewarding outcome for sheep. In a study designed by Kloke et al. (2014), they employed access to the home cage as a reinforcer for mice. The negative outcome has an even wider range of possibilities, from visually showing a dog to sheep to startling chickens by puffing air in their face (Deakin et al., 2016; Verbeek et al., 2014). More commonly, the absence of food, unpalatable food, white noise or light aversiveness was used (Burman et al., 2011; Duranton & Horowitz, 2019; Müller et al., 2012; Starling et al., 2014). The discriminative cue, as well as the positive and negative outcomes should be selected carefully depending on species-specific characteristics (Ramirez, 1999). The negative cue is especially delicate as it should balance between being aversive to facilitate the learning process and not be so aversive to impair it. It should be of minimal intensity, while still remaining effective. Other variations within the cognitive bias paradigm include the differences in the treatment (i.e. providing environmental enrichment, effect of positive treatment, effect of negative treatments), the dependent variable (i.e. latency to approach, amount of lever presses), the number of presentations of the intermediate cue and the statistical analyses. This makes reviewing the cognitive bias methodology extremely hard, and despite all this research, no clear consensus exists about a standard protocol, leaving researchers with the task of developing their own.

For the cognitive bias test on dogs, researchers mostly made use of spatial discrimination. To test if this was the most favourable choice, Roijendijk (2016) performed cognitive bias tests with both spatial and size discrimination (n = 50). The size discrimination test was based on two bowls, one with a diameter of 24 cm, while the other one had a diameter of 16 cm. Even though a studies showed that dogs are capable of distinguishing circles with a size difference of 20% (Byosiere et al., 2018), the test based on size discrimination worked considerably less than the tests based on spatial discrimination. The difference in latency between contacting the positive and negative cue was almost indistinguishable when using size discrimination. The author suggested this might be due to the fact that the dogs did not have an aerial view of the bowls, which made the difference less clear. It could also be attributed to the absence of standard for comparison as viewing just one bowl, without another one for contrast, might make the distinction more difficult. The hypothesis that object discrimination tasks might be more difficult for dogs to learn is also supported by previously executed tests. The number of trials required to reach the learning criterium showed similar ranges in spatial tasks by Müller et al. (2012), and Mendl et al. (2010), but in the research by Burman et al. (2011), who employed an object discrimination task, the amount of trials needed was much higher.

The positive outcome of choices in cognitive bias tests is generally the delivery of a food reward, with the negative outcome being no reward. For ethical reasons, dogs are rarely exposed to more negative events as these are done with other species. There is ongoing debate about how dogs perceive the effect of the lack of reward, with Mendl et al. (2010) suggesting that the absence of an expected reward is likely negative in valence and low in arousal, while the presence of a punisher would be negative in valence and high in arousal. Due to the lack of aversiveness, the dogs seem to make a less deliberate choice when running towards the negative cue, since there is no meaningful consequence. To combat this, this research strived to investigate the effects of a more aversive outcome of responding to the negative cue within the limitations of what was ethically acceptable. The investigated alteration was the addition of subsequent negative trials. We hypothesized that this would facilitate the learning process and guide them to making a more deliberate choice. However, the difference in latency between the positive and negative cue for this test was just as distinct as in the standard spatial discrimination task. The course of the test differed though, with dogs differentiating between the two cues much more rapidly compared to their performance in the standard spatial task. However, this added aversiveness did result in less dogs understanding the test (46%) compared to the standard test (70%), which might be attributed to a decrease in motivation caused by the set-up of the test. This decrease in motivation was also seen in the gradual increase of the latency for the positive cue, which was not visible in the test without added aversiveness.

Almost all cognitive bias protocols with dogs employ a go/no-go tasks with a defined learning criterion. Most commonly, researchers defined that the learning criterium was met when the longest latency to approach the positive position was longer than the shortest latency to approach the negative for a certain number of trials. Kis et al. (2015) and Müller et al. (2012) chose a total of 10 trials, while Mendl et al. (2010) required it for 3 trials for each position. In research by Duranton & Horowitz (2019), the learning criterion was reached when the dogs stopped going towards the negative bowl for 6 consecutive trials. A similar learning criterion was set for the second version of the test performed in this research. It was defined as the dogs taking longer than 10 seconds to reach the negative bowl for two consecutive negative trials. This criterion was met after an average of 18.8 trials, similar to the number of trials (18) employed in the first version. Because this research was based on voluntary participants that visited the research facility for at most 2 hours, a relatively low number of trials and an easily attainable learning criterion was employed. To obtain a higher percentage of dogs that discriminate between the two cues, the number of trials must be increased.

Assessing cognitive bias from the latencies to reach the cues, which is used in most cognitive bias tests on dogs, comes with some limitations, including the interpretation when dogs do not approach the cue. The dog might have decided not to approach, but it might do so for different reasons, such as being distracted, being fatigued or being satiated. Dogs not approaching cues because they were distracted was kept to a minimum by playing background music and by eliminating trials from data analysis where the dogs were clearly distracted or startled. To exclude the possibility that the lack of food motivation might influence the test results, a quantitative food motivation test was also employed. Almost all dogs still seemed interested in the food after performing the two cognitive bias tests, indicating that this was not a limiting factor for their motivation to participate in the test. A way to avoid these problems all together would be by implementing an active choice task, where the animal has to respond to a stimulus with an active response (aka pressing a lever). Limitation of these tasks include them being more difficult to train and taking up more time, possibly causing an added obstacle in the recruitment of participants. Repetition is essential for the learning process within the cognitive bias paradigm. Not only by the repetition of subsequent trials, as mentioned above, but also by the repetition of the test after a longer interval. In this research, the difference in latency towards the negative position was significantly higher the second time the dogs perform the test, suggesting that they remember the consequences of this cue. Such effects were less clear for the positive position, probably due to a ceiling effect, where the dogs couldn't run faster than they already did. There was no significant difference between the latency to approach the intermediate cue during the first test compared to the latency for the second test. But, contrastingly, research by Müller et al. (2012) did find that latencies to reach the intermediate probe were significantly longer on the second day of testing, suggesting that the dogs had learned that the ambiguous cue went unrewarded. This raises questions for the repeatability of the test, since the latencies might be influenced. For repeated measures of welfare, the test might not be ideal. This could also be seen in the moderate albeit significant correlation ($r = 0.49$) between the two optimism scores for the dogs that understood both tests.

In this research the results from the cognitive bias test were validated by comparing them with the owners' report on their dogs' optimism. The optimism scores obtained from the cognitive bias test did not seem to reflect the owners' report on their dogs' optimism. This inconsistency raises questions for both the method of inquiring about the optimism of a dog and the optimism bias results. To question the optimism of a dogs, two methods were employed. The owners were asked directly if they would describe their dog as optimistic or pessimistic by posing the question "If you consider the saying "the glass is half full or half empty", is the glass for your dog then A) half full or B) half empty?". The owners were also asked to score their dogs on a 5-point Likert scale, depending on how they found the word appropriate in describing their dog. Depending on how much the owners scored for words associated with optimism versus those associated with pessimism, the dogs were categorized as optimistic, and vice versa. For the method of asking them directly the majority of owners (206 out of 223; 92.4%) categorized their dog as optimistic. The method using the keywords associated with optimism showed 209 out of 220 (95%) considered their dog optimistic. Both methods revealed that almost all owners consider their dogs to be optimistic. This raises the question if owners are possibly reporting on a different trait than the one measured by the cognitive bias test. Alternatively, the cognitive bias test might be questioned and, for example, influenced especially by more transient affective states. A possible indicator for this is the effect of the previous position. The dogs seemed to show a significantly shorter latency to approach the negative location when the previous cue was positive, compared to when the previous cue was negative. If the dogs' reaction to events happening during the test itself influence the outcome, emotions could cloud the underlying emotional affect. An example of this is also seen in research performed by Burman et al. (2011), where the group of dogs experiencing a rewarding event (a search & forage task) before testing showed an unexpected pessimistic bias compared to the dogs that had not. The researchers speculate this result might have been due to the rewarding event ending, creating an emotion akin to disappointment. This could have influenced the affective state of the dog negatively. Another possibility is that the dogs in the group with no rewarding event, who received minimal human contact, might have seemed more optimistic due to their excitement. Similar results were found by Doyle et al. (2010), where they investigated the effect of stress due to restraining in sheep. They expected the restrained sheep to show a more pessimistic bias, but surprisingly, this group showed an apparent optimistic bias. The relief caused by the release from an aversive restraint might have carried over into the testing phase. The set-up of the test might also be arguably flawed for more anxious dogs. Throughout the experiments, anxious dogs or dogs showing more fear refused to participate, resulting in elimination from the research.

The objective of this research was to investigate the possible relationship between parenting styles and the emotional affective state of a dog. In children, various research has linked parenting styles to child development and well-being. Most studies seem to consider authoritative parenting the most ideal strategy, as this style is associated with the most positive outcomes for the child. We hypothesized that a similar correlation might exist between the parenting style of an owner and the well-being of their dog. Surprisingly, no correlations were found between the parenting styles of the owner and the optimism of their dog. Considering that the participants were all very motivated and dedicated owners, the population might not have been varied enough to find significant correlations. The effort and commitment to participate in a lengthy questionnaire, let alone behavioural tests, is almost inherently opposite to what a permissive or uninvolved parent would do. The statistics of the parenting styles also show very low scores for the authoritarian style, indicating that the participating owners mostly fell into the authoritative parenting style category. Attempts to recruit more authoritarian based owners were sadly unsuccessful. Nevertheless, a negative correlation between the parental demandingness that owners reported and the optimism score of the dogs was discovered. This raises the question if high demandingness is a good thing in raising a dog. Mainly the disciplinary practices associated with high demandingness are of questionable value when interacting with a dog. Disciplinary actions such as verbal scolding and physical punishment are thought to lead to aggressive tendencies and antisocial behaviour in children (MacKenzie, Nicklas, Waldfogel, & Brooks-Gunn, 2012). For dogs, these harsh actions are probably even more ineffective, considering that miscommunication is commonplace. There are also several studies that show a correlation between the use of positive punishment and behavioural problems in dogs. One of these studies investigated this relationship by using a questionnaire to find out which training method owners used while also noting the undesirable behaviour of the dog. Undesirable behaviour was assessed using an attention-seeking score, a fear or avoidance score and an aggression score. Dogs with owners using positive punishment methods had significantly higher aggression scores, as well as avoidance scores (Hiby, Rooney, & Bradshaw, 2004). This might indicate that the training method an owner employs might be of greater importance than the parenting style itself. Further research into this topic might provide more information on what relationship exists between parenting styles of the owner and the emotional affect of their dog. Steering dog owners towards a more appropriate parenting style could result in better relationships between dogs and their owner, preventing them from surrendering their dogs to shelters.

The aim of this study was to optimize the protocol for measuring cognitive bias in dogs. Specifically, I investigated two different discriminative cues and the dogs' responses to different outcomes of going to the negative cue. The tests based on spatial discrimination showed more differences in latency towards the positive and negative cue than tests based on visual discrimination. This indicates that, for dogs, discriminative stimuli based on spatial cues work better than those based on visual cues. The addition of aversiveness to the negative cue, in the form of subsequent trials being negative also (when they ran towards the bowl when in the negative position), resulted in differences in latency towards the positive and negative cue comparable to those of the standard test. In addition, the dogs seemed to discriminate between the cues faster than in the standard tests. However, when analysed individually, less dogs seemed to discriminate effectively between the two positions and this disadvantages the adapted protocol compared to the existing standard. Subsequently, the relationship between the owners' parenting style and the dogs' optimism bias was investigated. No correlations were found, except a negative correlation between the demandingness and a dogs' optimism score. This indicates that an owners' demandingness might be damaging for a dogs' positive emotional affect. In particular the positive punishment associated with high demandingness might be destructive to the well-being of the dog. Cognitive bias tests offer a promising new indicator of animal welfare, but many challenges have to addressed before it can be used as a reliable method for emotional affect. Additionally, further research into the relationship between the owners' parenting style and the dogs' optimism bias might benefit domestic dogs around the globe. By informing owners what style of parenting is most effective and beneficial to their dog could greatly improve the owner-dog relationship.

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APPENDIX

APPENDIX I: ADAPTED 17-ITEM DD-PSDQ

1. Ik sta toe dat mijn hond mijn besluiten beïnvloedt, bijvoorbeeld wat betreft de route tijdens de wandeling.
2. Ik troost mijn hond als hij overstuur is.
3. Ik houd de wensen van mijn hond in gedachten voordat ik hem vraag iets te doen.
4. Ik gebruik fysieke (lichamelijke) correcties (bijvoorbeeld een tik of een slipketting) als een manier om het gedrag van mijn hond te verbeteren.
5. Ik gebruik een corrigerende tik als mijn hond zich misdraagt.
6. Ik verhef mijn stem als mijn hond zijn gedrag moet verbeteren.
7. Ik zet een beloning in (voer/speeltje) als mijn hond echt iets moet doen.
8. Ik oefen gedrag stap voor stap met mijn hond, zodat ik zeker weet dat hij begrijpt wat ik van hem vraag.
9. Er zijn voor mijn hond gevolgen als hij ongewenst gedrag toont, zoals het verwijderen van een beloning of aandacht.
10. Ik gebruik regels en richtlijnen om het gedrag van mijn hond te verbeteren, zoals gaan zitten voor het krijgen van eten of op je mat liggen als er bezoek is.
11. Ik steun mijn hond als hij schrikt van een voorwerp of persoon.
12. Ik help mijn hond inzien wat gewenst gedrag is in sociale situaties die hij lastig vindt.
13. Ik weet wat mijn hond doet, zelfs als ik iets anders aan het doen ben in huis, zoals schoonmaken of een boek lezen.
14. Ik voorkom dat mijn hond anderen (mensen of dieren) lastigvalt.
15. Ik verwen mijn hond.
16. Ik voer het niet daadwerkelijk uit, als ik met straf dreig richting mijn hond.
17. Ermee dreigen doe ik vaker dan mijn hond daadwerkelijk corrigeren.

APPENDIX II: KEYWORDS ASSOCIATED WITH OPTIMISM

1. Hoopvol
2. Pessimistisch
3. Toegankelijk
4. Volhardend
5. Depressief
6. Vrolijk
7. Verdrietig
8. Optimistisch
9. Twijfelachtig
10. Aarzelend
11. Aanhoudend
12. Bezorgd
13. Enthousiast
14. Onzeker
15. Bedrukt
16. Zelfverzekerd

APPENDIX III: PYTHON CODE

```python
import sys
import random

length = int(sys.argv[1])
repetitions = int(sys.argv[2])

for rep in range(repetitions):
    output = []
    for i in range(length):
        newentry = random.choice(["N","P"])
        if len(output) > 2:
            if newentry == output[-1] and newentry == output[-2]:
                if newentry == "P":
                    output.append("N")
                elif newentry == "N":
                    output.append("P")
            else:
                output.append(newentry)
        else:
            output.append(newentry)

        if output.count('N') == 8 and output.count('P') == 10:
            print(str(rep)+"-"+"".join(output))
```

APPENDIX IV: COGNITIVE BIAS TEST

TABLE 7: PHASE I, COGNITIVE BIAS TEST: POSITION AND TRIAL NUMBER FOR BOTH VERSIONS, PHASE I.

Position	Trial
Training phase I	
Positive 1.0m	*1*
Positive 1.5m	*2*
Positive 3.0m	*3*
Positive 3.5m	*4*
Positive 4.5m	*5*

TABLE 8: EXAMPLE FOR PHASE II, COGNITIVE BIAS TEST VERSION 1: POSITION AND TRIAL NUMBER FOR PHASE II.

Position	Trial
Training phase II	
Negative	*1*
Positive	*2*
Positive	*3*
Negative	*4*
Positive	*5*
Negative	*6*
Positive	*7*
Negative	*8*
Positive	*9*
Positive	*10*
Negative	*11*
Positive	*12*
Negative	*13*
Positive	*14*
Positive	*15*
Negative	*16*
Negative	*17*
Positive	*18*

TABLE 9: EXAMPLE FOR PHASE II, COGNITIVE BIAS TEST VERSION 2: POSITION AND TRIAL NUMBER FOR PHASE II.

Position	Trial	Position	Trial
Training phase II			
Positive	*1*	*Positive*	*16*
Positive	*2*	*Negative*	*17*

Positive	*3*	*Negative*	*18*
Negative	*4*	*Positive*	*19*
Negative	*5*	*Positive*	*20*
Positive	*6*	*Negative*	*21*
Positive	*7*	*Negative*	*22*
Negative	*8*	*Positive*	*23*
Positive	*9*	*Negative*	*24*
Positive	*10*	*Negative*	*25*
Negative	*11*	*Positive*	*26*
Negative	*12*	*Negative*	*27*
Positive	*13*	*Positive*	*28*
Negative	*14*	*Negative*	*29*
Negative	*15*	*Negative*	*30*

TABLE 10: PHASE III, COGNITIVE BIAS TEST VERSION 1: TWO POSSIBILITIES FOR THE POSITION AND TRIAL NUMBER FOR THE PHASE III.

Position	Trial
Phase III	
Positive	*1*
Negative	*2*
Positive	*3*
Middle	*4*

Position	Trial
Phase III	
Positive	*1*
Positive	*2*
Negative	*3*
Middle	*4*

TABLE 11: PHASE III, COGNITIVE BIAS TEST VERSION 2: POSITION AND TRIAL NUMBER FOR THE PHASE III.

Position	Trial
Phase III	
Positive	*1*
Negative	*2*
Middle	*3*

APPENDIX V: FORM COGNITIVE BIAS TEST

Form Cognitive bias test

General information

Dog ID
Voter ID
Name
Age
Breed
Gender

Randomisation

Sequence of tests	1, 2	2, 1
Positive bowl	Left	Right
Version 1, Phase III	A	B
Version 1, sequence phase II		
Version 2, sequence phase II		

Cognitive bias test: Version 1

Phase I

Position	Trial
P 1m	1
P 1.5m	2
P 3m	3
P	4
P	5

Phase II

Sequence

Position	Trial	Order_within	Latency
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	13		
	14		
	15		
	16		
	17		
	18		

Phase III

A

Position	Trial	Order_within	Latency
P	19	11	
N	20	9	
P	21	12	
Middle	22	1	

B

Position	Trial	Order_within	Latency
P	19	11	
P	20	12	
N	21	9	
Middle	22	1	

Cognitive bias test: Version 2

Phase I

Position	Trial
P 1m	1
P 1.5m	2
P 3m	3
P	4
P	5

Phase II

Sequence

Position	Trial	Order_within	Latency
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	13		
	14		
	15		
	16		
	17		
	18		
	19		
	20		
	21		
	22		
	23		
	24		
	25		
	26		
	27		
	28		
	29		
	30		

Phase III

Position	Trial	Order_within	Latency
P			
N			
Middle			