Paper

Timing and presence of an attachment person affect sensitivity of aggression tests in shelter dogs

A. Kis, B. Klausz, E. Persa, Á. Miklósi, M. Gácsi

Different test series have been developed and used to measure behaviour in shelter dogs in order to reveal individuals not suitable for re-homing due to their aggressive tendencies. However, behavioural tests previously validated on pet dogs seem to have relatively low predictability in the case of shelter dogs. Here, we investigate the potential effects of (1) timing of the behaviour testing and (2) presence of a human companion on dogs' aggressive behaviour. In Study I, shelter dogs (n=25) showed more aggression when tested in a short test series two weeks after they had been placed in the shelter compared to their responses in the same test performed 1–2 days after arrival. In Study II, the occurrence of aggressive behaviour was more probable in pet dogs (n=50) in the presence than in the absence of their passive owner. We conclude that the sensitivity of aggression tests for shelter dogs can be increased by running the test in the presence of a caretaker, and after some period of acclimatisation to the new environment. This methodology could also provide better chances for successful adoption.

Introduction

Millions of dogs are relinquished to animal shelters each year (eg, Tuber and others 1999, Mondelli and others 2004, Shore 2005). There is some evidence that physical characteristics, such as health, age, breed (eg, New and others 2000) may play a role in relinquishment, but more importantly, behavioural problems make it most likely that a dog ends up in a shelter (eg, Salman and others 2000, Mondelli and others 2004). Aggression is the most common behavioural reason to surrender a dog to a shelter (van der Borg and others 1991, Salman and others 2000, Stephen and Ledger 2007, Diesel and others 2008), and also for the 'euthanasia' of healthy but not adoptable dogs in shelters (Marston and others 2004).

A large number of people are treated day by day in emergency rooms as a result of dog bites (Newman and others 2010) carrying a pronounced financial impact (Overall and Love 2001). Shelter dogs with hidden aggressive tendencies can cause serious problems when reintroduced to our society. This is probably the main motivation behind the development of behavioural tests that could prevent the re-homing of aggressive dogs. Several complex behavioural tests (eg, Netto and Planta 1997, Wilsson and Sundgren 1997, Planta and De Meester 2007, van der Borg and others 2010) and questionnaires (eg, van den Berg and others 2010) developed to measure aggression had already been validated on the pet dog population, and some of them were applied to shelter dogs as well (eg, van der Borg and others 1991, De Palma and others 2005, Segurson and others 2005). However, these behaviour tests had a relatively low predictive value in the case of shelter dogs, mainly due to the many false negative results (Christensen and others 2007); a large proportion of dogs that had not showed aggression during the test behaved aggressively after adoption.

The aim of the present study was to reveal some potential reasons for the low sensitivity of aggression tests in the case of shelter dogs. In our first experiment, we tested whether the timing of the test (on the day of arrival or two weeks later) had an effect on shelter dogs' aggressive behaviour. In our second experiment, we observed to what extent and how the absence or presence of the owners during the behavioural test altered pet dogs' aggressive responses.

Study I

Background

According to our first hypothesis, the inappropriate timing of the behavioural assessment might contribute to the low sensitivity of aggression tests carried out in shelter dogs (Christensen and others 2007). Previous studies suggest that the cortisol level of shelter dogs is higher than that of pet dogs at home environment, but it decreases with time spent in the shelter (Hennessy and others 1997, Stephen and Ledger 2006). Furthermore, the cortisol level of shelter dogs is related to timidity (Hennessy and others 2001) which could lead to suppressed behavioural responsiveness, and parallel to this reacting with avoidance instead of confrontation to the changes of environment. Based on these findings, we predicted that shelter dogs would be more reactive, and therefore showing more aggression, in a behavioural test after spending some time in the shelter than immediately after arrival.

Veterinary Record (2014) doi: 10.1136/vr.101955

A. Kis, MSc
B. Klausz, MSc
E. Persa, MSc
Á. Miklósi, DSc
Department of Ethology, Eötvös Loránd University, Pázmány P. 1/c., Budapest H-1117, Hungary
A. Kis, MSc
Research Centre for Natural Sciences, Hungarian Academy of Sciences, Magyar Tudósok körútja 2, Budapest H-1117, Hungary
Á. Miklósi, DSc
M. Gácsi, PhD
MTA-ELTE Comparative Ethology Research Group, Pázmány P. 1/c, Budapest H-1117, Hungary

E-mail for correspondence: kisanna12@gmail.com

Provenance: Not commissioned; externally peer reviewed

Accepted January 8, 2014

Method

Subjects

A total of 95 adult (>1 year) shelter dogs participated in the test during a 5-month period in the 'Illatos út' Animal Health Institute, Budapest, Hungary. Dogs were housed in individual kennels that were cleaned once a week. Apart from this, human contact included seldom on-leash walks based on the availability of the staff. Twenty-five dogs (17 males and eight females, average age: 3.44±2.5 years) could be retested two weeks after the first test and were included in the detailed analysis (the others had been adopted, taken by breed-rescue associations, or claimed by the original owners before the second test). There was no difference in the age of the adopted (mean±sd: 3.51±1.93) versus the retested subsample (independent samples *t* test, $t_{(93)}$=0.157, P=0.876), nor in the gender distribution (male/female: 50/20 v 17/8, Fisher's exact test, P=0.801), nor in the proportion of pure breed/mixed breed dogs (15/60 v 2/23, Fisher's exact test, P=0.226). Due to the procedures at the shelter we did not have any additional information about the subjects, for example, the reason for surrender or about the owners that adopted them.

Procedure

Subjects were first tested one or two days after entering the shelter. We adopted a practical and short test procedure that proved to be effective in a recent study on a group of privately owned pet dogs (Klausz and others 2014). Our main consideration in choosing this test series was to cause the least possible stress to the dogs tested (the number of tests was reduced to a minimum, thus, testing was kept as short in duration as possible, while at the same time during all tests the subjects had the possibility to choose between a fight or flight response as the experimenter never followed a dog that showed avoidance response). To guarantee the safety of the experimenter an artificial hand was used in tests with possible physical contact and the experimenter never entered the chain range of the dog.

All tests were carried out in a visually separated unfamiliar open-air area inside the shelter. Dogs were tethered to a tree and a spike (located about 3 m from each other), with two 3 m-long light chains in a V shape (Fig 1). This type of leashing prevents the dog from making semicircular movements, but allows it to move relatively long distances ahead and back.

The test series consisted of three tests with each test taking about 30–60 seconds. It was carried out with only a brief break (5–10 seconds) necessary to prepare the subsequent test, thus the whole test series took about 3 minutes per dog. Two female experimenters (E1: 29 years old and E2: 22 years old) participated in the test series with both of them being unfamiliar to the dogs. In Tests 1 and 2, E1 used an artificial hand. It was a very natural-looking model of a hand, made of plaster and covered with a glove. The artificial hand could be operated by a stick covered with a sleeve to hide the hand of the test-person. The behaviour of the human participants was determined and standardised according to several 'If . . . then . . . ' rules.

Test 1—*Friendly greeting:* E1 approaches the dog in normal walking speed while speaking in a friendly manner to the dog and maintaining eye contact with it. She stops at 1 m from the dog. Then, she calls the dog by its name, steps closer if the dog approaches her without showing any sign of aggression, and strokes it gently on the head with the artificial hand. E1 continues calling the dog for 30 seconds even if it shows aggression or avoids her, but she never goes closer than the chain range.

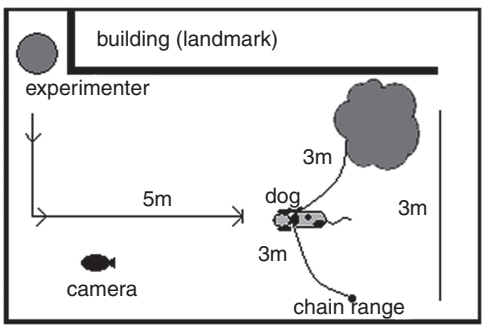

FIG 1: The schema of the test area

Test 2—*Take away bone:* For this test we use a bone attached to a string. E1 gives the bone to the dog to chew it while she holds the end of the string. The bone is always positioned a few centimetres inside the chain range, so that the dog can choose either to approach the experimenter and the bone or to avoid both of them. If the dog is in physical contact with the bone, then after 5 seconds the experimenter strokes the dog's head with the artificial hand while talking to it quietly (5 seconds); then she reaches towards the bone, puts the hand on the bone and says 'Give it to me!'; then without saying anything holds her hand on the bone next to the muzzle of the dog (5 seconds); finally, she takes away the bone from the dog by pulling the rope with her other hand while the artificial hand remains on the bone pretending that she is pulling the bone with it. The test is terminated if the dog (a) tries to attack E1, (b) allows her to take the bone away, or (c) does not become in physical contact with the bone.

Test 3—*Threatening approach:* E2 approaches the dog slowly, slightly leaning ahead and staring into the dog's eyes (for detailed description see Vas and others 2005). The test ends when the experimenter reaches the chain range or when the dog reacts with aggression or avoidance.

All tests were video recorded by the non-testing experimenter, and analysed later.

In order to assess possible behavioural changes two weeks after the first test, dogs participated in the same test series applying the same procedure, test place and experimenters.

Data analysis

We selected and defined the relevant variables (Table 1) based on the findings from an earlier pilot study on 12 shelter dogs and on the results of our study on pet dogs (Klausz and others 2014). As *Fear* proved to be of crucial importance in the above study, we decided to thoroughly study related behaviours and coded *Fear-submission* and *Anxiety-discomfort* using time% instead of 0/1 score.

Interobserver agreements between E1 and E2 for all variables were assessed by means of parallel coding of 14 randomly chosen tests. High values were calculated in all cases (see Cohen κ coefficients in Table 1).

We used paired *t* test to compare the behaviour showed in the two tests in case of normally distributed data (fear—submission and anxiety—discomfort) and non-parametric methods (aggression: Wilcoxon signed-rank test; physical contact: χ^2 test) when the data was not normally distributed according to the Kolgomorov-Smirnov test.

Results

Generally, the level of aggression was low when dogs (n=95) were tested for the first time, 1–2 days after entering the shelter. In the friendly greeting test, one dog, in the take away bone test 18 dogs, and in the threatening approach test two dogs showed some form of aggression. Importantly, no difference was found in the responses of dogs that could not be assessed in the second tests (n=70) and of those that were later retested (n=25) (for all tests P>0.05, Mann-Whitney test). In order to resolve the unbalanced nature of the sample, we took a random sample of 25 subjects from the adopted population (n=70) and compared that to the retested sample (n=25). This comparison did not yield any significant results either (Friendly greeting: U=275.00, P=1.00; Take away bone: U=245.00, P=0.351; Threatening approach: U=264.00, P=0.348).

Comparing the behaviour of dogs that participated in both tests (n=25) we found that in the friendly greeting test none of them showed any form of aggression on either occasion. Furthermore, we did not find any difference among the two occasions regarding fear—submission ($t_{(24)}$=1.634; P=0.115) and anxiety—discomfort ($t_{(24)}$=1.611; P=0.120).

In the take away bone test, however, more dogs came in physical contact with the bone on the second occasion (no physical contact in case of three dogs in any of the two occasions, physical contact only on the second occasion in case of seven dogs, and physical contact on both occasions in case of 15 dogs; χ^2=5.114; P=0.024). Dogs also showed more aggression towards the experimenter on the second occasion (15 dogs showed no aggression in any of the two occasions, five dogs showed no aggression on the first occasion, but growled

TABLE 1: Names and definitions of the variables coded in the different tests

Test	Variable	Type of variable	Definition of the variable	Cohen's κ
Friendly greeting	Fear—submission	Time percentage	Tail wagging between the legs, dipped head, tensed posture, lay on back	1.0
	Anxiety—discomfort	Occurrence	Muzzle licking, scratching, yawning	0.81
	Aggression*	Score	0 – no aggression; 1 – growling, 2 – snarling; 3 – snapping with/without attack; 4 – biting	1.0
Take away bone	Physical contact	0/1	0 – no contact, 1 – dog is in physical contact with the bone: holding, licking, chewing or laying on it	1.0
	Aggression*	Score	0 – no aggression; 1 – growling, 2 – snarling; 3 – snapping with/without attack; 4 – biting	1.0
Threatening approach	Fear—submission	Time percentage	Tail wagging between the legs, dipped head, tensed posture, lay on back	1.0
	Anxiety—discomfort	Occurrence	Muzzle licking, scratching, yawning	0.81
	Aggression*	Score	0 – no aggression; 1 – growling, 2 – snarling; 3 – snapping with/without attack	1.0

*Score 0=no aggression (none of the following behaviours); Score 1=growling (acoustic threats; low buzzing sound); Score 2=snarling (the dog pulls up its upper lip, so that its teeth are visible); Score 3=snapping with or without acoustic and visual threats with incomplete approach (the obvious aim of the biting, an open muzzled movement towards the artificial hand or arm, without the total contact with it); Score 4=biting with or without acoustic and visual threats (the artificial hand/arm totally gets into the jaws of the dog) – following Netto and Planta (1997). Barking, staring and the rigid posture without snarling or growling were not noted as aggressive behaviour elements (following Christensen and others 2007)

on the second occasion, three dogs showed some aggression (one growled, two snarled) on the first occasion and showed more severe forms of aggression (one snarled, two bit) on the second occasion, while two dogs showed the same forms of aggression (one snarled, one bit) on both occasions; Z=2.640; P=0.008) (Fig 2).

In the threatening approach test, only one dog was aggressive on both occasions. No difference could be observed regarding fear—submission between the two test occasions ($t_{(24)}$=0.559; P=0.581). However, for the second time, dogs showed more anxiety—discomfort ($t_{(24)}$=2.187; 0.039).

Discussion

In sum, similar to previous findings (Christensen and others 2007, but see van der Borg and others 1991), we observed that, in general, aggressive responses were rather rare in shelter dogs during the behaviour test, that is, compared to the recent study of Klausz and others (2013) on a Hungarian pet dog population. Nevertheless, the timing of the test (1–2 days after getting into the shelter vs two weeks later) might have some influence in eliciting aggression from the dogs because our subjects showed more aggression in the take away bone test on the second occasion. We also note that the dogs included in this study were only a subsample, as some of them had been adopted, taken by breed-rescue associations, or claimed by the original owners before the second test. Although we did not find any difference in the aggressive behaviour of the total sample and our subsample, we cannot exclude any possible biases that could have showed up only at the second test.

Study II

Background

In Study I, we found that testing dogs shortly after they had been placed in a shelter does not sufficiently explain the low prevalence of aggression. Aggressive behaviours in our test were also relatively rare even after our subjects had spent two weeks in the shelter. Comparing the applied test procedure to that conducted with owned pet dogs (Klausz and others 2014), one important difference is that shelter dogs are tested in the absence of a human attachment figure. Previous results suggest that this might be a notable difference because of dogs' attachment towards their owners (Topál and others 1998, Prato-Previde and others 2003) which implies that owners might serve as a secure base to dogs (Gácsi and others 2013). Furthermore, De Meester and others (2011) found some evidence that the presence and absence of the owners explained most of the variance in a Principal Component Analysis study analysing postures and behaviour strategies during the Socially Acceptable Behaviour Test.

Based on these previous findings, we assumed that dogs would show more aggression when tested in the presence of a human partner who can provide a secure base in conflict situations. To test our hypothesis, we observed and compared the behaviour of pet dogs in the same test in the presence and in the absence of their owner.

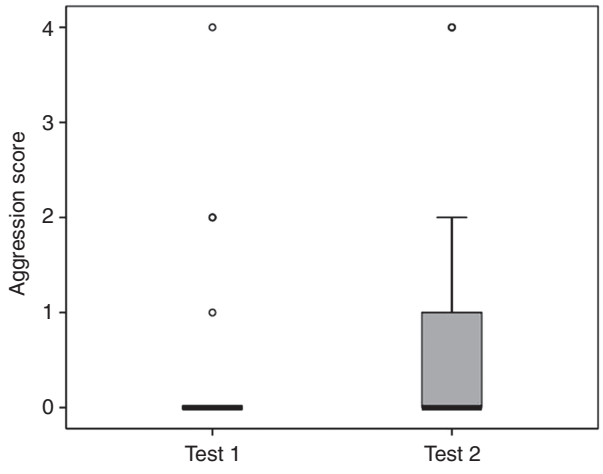

FIG 2: Aggression scores in the Take away bone test in Study I (median, quartiles, whiskers, outliers)

Method

A total of 50 adult (>1 year) pet dogs (from 24 different breeds and 15 mongrels, 22 males and 28 females, mean age 3.72±2.32 years) participated in the behaviour test described in Study I. The subjects were randomly selected from a database containing approximately 900 dog owners who had volunteered to participate in the behavioural tests of the Family Dog Project of Eötvös University, Budapest. Subjects were tested individually in a visually separated unfamiliar open-air area at the Top Mancs dog training school. All of them participated twice in the same test series, once with the owner being present and once without the owner. The two tests were performed in random order within a 1–3 weeks period. The test procedure and the data analysis were executed in the same way as in the case of the shelter dogs (for interobserver agreement see Table 1).

Results

In the friendly greeting test, two dogs showed aggression with and without the owner, while all other dogs showed no aggression on either of the two occasions. The presence of the owner did not influence the fear—submission ($t_{(49)}$=0.379; P=0.707), but we did observe a higher level of anxiety-discomfort when dogs were tested without the owner present (Z=2.140; P=0.032).

No difference was found in the take away bone tests in whether the subjects were in physical contact with the bone (χ^2=1.317; P=0.251). Nevertheless, dogs showed more aggression when tested with their ownerspresent; 40 dogs showed no aggression either with or without the owner, eight dogs showed no aggression without the owner, but growled (four), snarled (one) attacked (one) or bit (one) with the owner, one dog showed some aggression (growled) without the owner but showed more severe forms of aggression (bit) with the owner and one dog showed the same forms of aggression (bit) with and without the owner; Z=2.354; P=0.019.

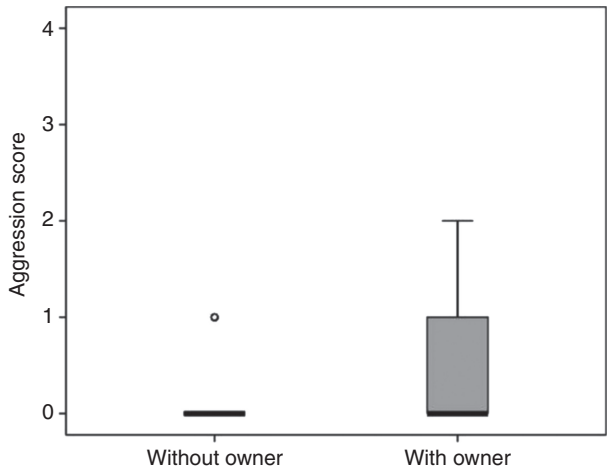

FIG 3: Aggression scores in the Threatening approach test in Study II (median, quartiles, whiskers, outliers)

During the threatening approach, dogs behaved more aggressively when tested with the owner; 32 dogs showed no aggression either with or without the owner, 12 dogs showed no aggression without the owner but growled with the owner, one dog growled without the owner, but snarled with the owner, and five dogs growled with and without the owner; Z=2.673; P=0.008) (Fig 3) but we did not find any difference in fear-submission ($t_{(49)}$=0.110; P=0.913) and behaviours related to anxiety-discomfort (Z=0.778; P=0.437).

Discussion

In sum, the results supported our hypothesis, that dogs show more aggression when tested with their owners. This fact might explain the previously found low prevalence of aggression in the case of shelter dogs that are always tested without a human partner.

General discussion

To our best knowledge, in previous aggression tests, timing has not been considered as an important factor. Authors do not report the time dogs spent in the shelter prior to testing. One exception is provided by Bollen and Horowitz (2008) who claimed to test dogs only after allowing them enough time to get acclimatised to the shelter environment determined by the dog's willingness to exit the kennel, run for walks and its willingness to eat and drink normally while in confinement (minimum=48 hours, maximum=96 hours). However, the results by Stephen and Ledger (2006) suggest that in shelter dogs, the level of cortisol does not return to baseline levels until day 31, thus, one can assume that dogs need to spend several weeks (possibly even more than in the present study) in the shelter before their reactivity approaches appropriate levels. Our current findings suggest that dogs show more aggression in a behavioural test after having spent two weeks in the shelter at least in certain situations (take away bone). This observation seems to be in agreement with the hormonal data collected in a different shelter (Hennessy and others 2001) because cortisol level returning to normal may facilitate the emergence of aggressive behaviours through normalising the responsiveness. However, we cannot exclude the alternative hypothesis that the difference we found between the first and the second test is due to an order effect (eg, subjects being sensitised to threatening stimuli), although in a previous study (Klausz and others 2014) we found that the behaviour of pet dogs was consistent across time in the same test procedure. Moreover, other authors (Svartberg and others 2005) have found that the intensity of aggression even decreased from test 1 to test 2. In order to properly clarify this issue, and to prove the mediating effect of cortisol, further studies are needed.

Although our findings point out the importance of timing of the aggression test, based solely on these results we cannot conclusively determine the time dogs need to spend in the shelter before the aggression test so as to achieve maximum sensitivity. Therefore, further studies are needed to examine aggression showed by shelter dogs after spending different amounts of time in the shelter. Another important issue is that besides spending time passively in the shelter and thus getting habituated to the new environment, human handling sessions can also reduce cortisol levels in shelter dogs (Coppola and others 2006, Menor-Campos and others 2011). These two factors, the timing of the test and housing conditions (especially human contact), might interact with each other and, thus, should be controlled carefully. A further limitation from the applied perspective is that the tests we applied only measure aggression directed towards strangers (Klausz and others 2014), whereas, aggression towards the owner and other family members is also a common complaint about dogs adopted from a shelter (Christensen and others 2007). Furthermore, as the prevalence of aggression in shelter dogs was relatively low even after spending two weeks in the shelter, future studies should address the generalisability of our findings.

We also revealed that the presence of the pet dogs' owners had a facilitating effect on dogs' aggressive behaviour during the testing. This observation may help to explain the low levels of aggression in shelter dogs in the present study, and the low predictability of previous aggression tests applied to shelter dogs (Christensen and others 2007). Gácsi and others (2001) found that adult dogs in a shelter environment can form an attachment relationship with an unfamiliar human only after a few handling sessions. Therefore, such an attachment person (eg, the caretaker/handler of the dog) could play the role of the owner during the aggression tests. The increased sensitivity of the test could be expected because the suggested changes to the testing procedure mimic more closely the situation in real life. Furthermore, with the involvement of such a caretaker/handler, additional tests trying to assess (future) owner-directed aggression might be carried out.

In sum, we have provided evidence that time spent in the shelter and the presence of a human companion affect the aggressive behaviour of dogs in test situations. Although the predictive value of this test for dogs' behaviour after homing should be further studied, taking these factors into consideration when evaluating shelter dogs could definitely increase the predictability of adoption suitability.

Acknowledgement

We would like to thank the 'Illatos út' Animal Health Institute and the Top Mancs dog school for their help with recruiting subjects. The research was funded by the Hungarian Scientific Research Fund (K 84036; K100695).

References

BOLLEN, K. & HOROWITZ, J. (2008) Behavioral evaluation and demographic information in the assessment of aggressiveness in shelter dogs. *Applied Animal Behaviour Science* **112**, 120–135

CHRISTENSEN, E., SCARLETT, J., CAMPAGNA, M. & HOUPT, K. (2007) Aggressive behavior in adopted dogs that passed a temperament test. *Applied Animal Behaviour Science* **106**, 85–95

COPPOLA, C. L., GRANDIN, T. & ENNS, R. M. (2006) Human interaction and cortisol: can human contact reduce stress for shelter dogs? *Physiology & Behavior* **87**, 537–541

DE MEESTER, R. H., PLUIJMAKERS, J., VERMEIRE, S. & LAEVENS, H. (2011) The use of the socially acceptable behavior test in the study of temperament of dogs. *Journal of Veterinary Behavior: Clinical Applications and Research* **6**, 211–224

DE PALMA, C., VIGGIANO, E., BARILLARI, E., PALME, R., DUFOUR, A. B., FANTINI, C. & NATOLI, E. (2005) Evaluating the temperament in shelter dogs. *Behaviour* **142**, 1307–1328

DIESEL, G., BRODBELT, D. & PFEIFFER, D. (2008) Reliability of assessment of dogs' behavioural responses by staff working at a welfare charity in the UK. *Applied Animal Behaviour Science* **115**, 171–181

GÁCSI, M., MAROS, K., SERNKVIST, S., FARAGó, T. & MIKLóSI, Á. (2013) Human analogue safe haven effect of the owner: behavioural and heart rate response to stressful social stimuli in dogs. *PLoS ONE* **8**, e58475

GÁCSI, M., TOPáL, J., MIKLóSI, Á., DóKA, A. & CSáNYI, V. (2001) Attachment Behavior of Adult Dogs (*Canis familiaris*) Living at Rescue Centers: Forming New Bonds. *Journal of Comparative Psychology* **115**, 423–431

HENNESSY, M. B., DAVIS, H. N., WILLIAMS, M. T., MELLOTT, C. & DOUGLAS, C. W. (1997) Plasma cortisol levels of dogs at a county animal shelter. *Physiology & Behavior* **62**, 485–490

HENNESSY, M. B., VOITH, V. L., MAZZEI, S. J., BUTTRAM, J., MILLER, D. D. & LINDEN, F. (2001) Behavior and cortisol levels of dogs in a public animal shelter, and an exploration of the ability of these measures to predict problem behavior after adoption. *Applied Animal Behaviour Science* **73**, 217–233

KLAUSZ, B., KIS, A., PERSA, E., MIKLóSI, Á. & GáCSI, M. (2013) A quick assessment tool for human-directed aggression in pet dogs. *Aggressive Behavior* doi: 10.1002/ab.21501

MARSTON, L. C., BENNETT, P. C. & COLEMAN, G. J. (2004) What happens to shelter dogs? An analysis of data for 1 year from three Australian shelters. *Journal of Applied Animal Welfare Science* **7**, 27–47

MENOR-CAMPOS, D. J., MOLLEDA-CARBONELL, J. M. & LóPEZ-RODRÍGUEZ, R. (2011) Effects of exercise and human contact on animal welfare in a dog shelter. *Veterinary Record* **169**, 388

MONDELLI, F., PRATO-PREVIDE, E., VERGA, M., LEVI, D., MAGISTRELLI, S. & VALSECCHI, P. (2004) The bond that never developed: adoption and relinquishment of dogs in a rescue shelter. *Journal of Applied Animal Welfare Science* **7**, 253–266

NETTO, W. J. & PLANTA, D. J. U. (1997) Behavioural testing for aggression in the domestic dog. *Applied Animal Behaviour Science* **52**, 243–263

NEW, J., SALMAN, M. D., KING, M., SCARLETT, J. K. P. & HUTCHISON, J. (2000) Characteristics of shelter-relinquished animals and their owners compared with animals and their owners in U.S. pet-owning households. *Journal of Applied Animal Welfare Science* **3**, 179–201

NEWMAN, J., WESTGARTH, C., PINCHBECK, G., DAWSON, S., MORGAN, K., & CHRISTLEY, R. 2010. Systematic review of human-directed dog aggression. *Veterinary Record* **166**, 407

OVERALL, K. L. & LOVE, M. (2001) Dog bites to humans–demography, epidemiology, injury, and risk. *Journal of the American Veterinary Medical Association* **218**, 1923

PLANTA, J. & DE MEESTER, R. H. (2007) Validity of the Socially Acceptable Behavior (SAB) test as a measure of aggression in dogs towards non-familiar humans. *Vlaams Diergeneeskundig Tijdschrift* **76**, 359–368

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

SALMAN, M.D., HUTCHISON, J., RUCH-GALLIE, R., KOGAN, L., NEW, J., KASS, P., & SCARLETT, J. (2000) Behavioral reasons for relinquishment of dogs and cats to 12 Shelters. *Journal of Applied Animal Welfare Science* **3**, 93–106

SEGURSON, S., SERPELL, J. & HART, B. L. (2005) Evaluation of a behavioral assessment questionnaire for use in the characterization of behavioral problems of dogs relinquished to animal shelters. *Journal of the American Veterinary Medical Association* **227**, 1755–1761

SHORE, E. R. (2005) Returning a recently adopted companion animal: adopters' reasons for and reactions to the failed adoption experience. *Journal of the American Veterinary Medical Association* **8**, 187–198

STEPHEN, J. M. & LEDGER, R. (2006) A longitudinal evaluation of urinary cortisol in kennelled dogs, *Canis familiaris*. *Physiology & Behavior* **87**, 911–916

STEPHEN, J. M. & LEDGER, R. (2007) Relinquishing dog owners' ability to predict behavioural problems in shelter dogs post adoption. *Applied Animal Behaviour Science* **107**, 88–99

SVARTBERG, K., TAPPER, I., TEMRIN, H., RADESATER, T. & THORMAN, S. (2005) Consistency of personality traits in dogs. *Animal Behaviour* **69**, 283–291

TOPáL, J., MIKLóSI, Á., CSáNYI, V. & DóKA, A. (1998) Attachment behavior in dogs *(Canis familiaris):* A new application of Ainsworth's (1969) Strange Situation Test. *Journal of Comparative Psychology* **112**, 219–229

TUBER, D. S., MILLER, D. D., CARIS, K. A., HALTER, R., LINDEN, F. & HENNESSY, M. B. (1999) Dogs in animal shelters: problems, suggestions, and needed expertise. *Psychological Science* **10**, 379–386

VAN DEN BERG, S. M., HEUVEN, H. C. M., VAN DEN BERG, L., DUFFY, D. L. & SERPELL, J. (2010) Evaluation of the C-BARQ as a measure of stranger-directed aggression in three common dog breeds. *Applied Animal Behaviour Science* **124**, 136–141

VAN DER BORG, J. A. M., BEERDA, B., OOMS, M., DE SOUZA, A. S., VAN HAGEN, M. & KEMP, B. (2010) Evaluation of behaviour testing for human directed aggression in dogs. *Applied Animal Behaviour Science* **128**, 78–90

VAN DER BORG, J. A. M., NETTO, W. J. & PLANTA, D. J. U. (1991) Behavioural testing of dogs in animal shelters to predict problem behaviour. *Applied Animal Behaviour Science* **32**, 237–251

VAS, J., TOPÁL, J., GACSI, M., MIKLÓSI, Á., & CSÁNYI, V. 2005. A friend or an enemy? Dogs' reaction to an unfamiliar person showing behavioural cues of threat and friendliness at different times. Applied Animal Behaviour Science **94**, 99–115.

WILSSON, E. & SUNDGREN, P. E. (1997) The use of a behaviour test for the selection of dogs for service and breeding, I: Method of testing and evaluating test results in the adult dog, demands on different kinds of service dogs, sex and breed differences. *Applied Animal Behaviour Science* **53**, 279–295